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Agriculture

Volume LXV Number 3 June 1958

EDITORIAL OFFICES
THE MINISTRY OF AGRICULTURE, FISHERIES AND FOOD
WHITEHALL PLACE · LONDON S.W.1 · TRAFALGAR 7711

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Cover photograph: Free for all *Photo: Planet News*

Silage for Milk and Meat

PROFESSOR H. IAN MOORE, M.SC., PH.D., N.D.A., DIP.AGRIC.(CANTAB.)
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We are only on the fringe of the scope which silage offers as the kingpin of winter feeding policies for cattle and sheep says Prof. Ian Moore.

DURING the last ten years, grass—the most precious asset in farming today—has become the keystone of the feeding policy for cattle and sheep on the Seale-Hayne College Farm. In consequence, grass silage is the principal food during the winter months.

The place of silage as a feedingstuff in the economy of the farm depends on two vital considerations: it must be of high feeding value and, in comparison with alternative foodstuffs, it must show appreciable economies. Unless the silage is good the stock will refuse to eat it or will fare badly, and their performance will be unsatisfactory. This means loss of money and loss of potential. But however good the silage may be, so far as the feeding value goes, the crucial test is that of cost, for most of us farm for a living. Let us take this point first.

On the Seale-Hayne College Farm the comparative costs in 1957 were:

Crop	*Cost per ton of starch equivalent*
	s. *d.*
Grazing	11 0
Grass silage	17 2
Kale	16 9
Hay	29 7
Arable silage	34 0
Dairy cake (at £35 per ton)	53 8

It is well to remember that these costs (other than that for dairy cake) could be substantially reduced if the farm were purely commercial and not concerned with teaching and research. Nevertheless it is crystal clear that grass is the cheapest food for herbivorous animals and should therefore be exploited to the full. And not only is it the cheapest food; it is also the simplest to feed. Thus farmers should go all out to secure the longest possible grazing season. Many modern aids and techniques, fertilizers and equipment, and new varieties and strains can be used. Though some parts of the country are favoured with a longer grazing season than others, the winter feeding period is inevitable, and here the table shows grass silage and kale running neck and neck on the score of cheapness. Evidently kale is worth growing to extend the grazing season where conditions allow it to be grazed *in situ* and it can be relied upon to give a good yield, say 25 tons or more per acre.

Not all soils are suitable for the treading of stock in winter, although with modern cultivating equipment there is more scope today than there was twenty years ago to offset the effects of poaching. On some farms the problem of poaching has been overcome by taking two kale crops in succession.

After the first there is ample time to repair any soil damage before sowing the second, and if this is consumed first in the season there is a reasonable chance of its being eaten while soil conditions are reasonably good for grazing. What is more, there is time left to sow a spring cereal if need be. In the milder south and south-west, kale continues to grow and remain green and succulent into the new year, but this is not so evident in the north and east, where silage is likely to come into the rations much earlier. Quite apart from the question of poaching, there is the personal attitude to kale grazing. Many farmers hate to see their dairy cows consuming frosted kale or hock deep in mud or hunched up in pouring rain when they could be eating silage (at the same unit cost) in comfort. Moreover, on stony ground abrasions of the softened hoof are not uncommon. For my own part I believe there is much to be gained, even at some added expense, by giving the milking cow a little comfort.

Silage for milk makes economic sense

There is, therefore, a clear case on economic grounds for making silage. But, as I indicated earlier, it must be *good* silage. When grass is cut before flowering and properly ensiled under cover, there is a reasonable chance of getting a product with a crude protein content of 15 per cent or more and a dry matter content of 20 per cent or more. This silage can be regarded as a production food, and 16–20 lb can be fed per gallon of milk to replace 3½–4 lb of concentrated food, thereby slashing the costs of winter feeding. If, however, the silage is not of this quality, because a much more mature crop or a wet one (which gives rise to the wrong kind of fermentation) was ensiled, or the silage was diluted with rainwater, more will be required to provide the necessary nutrients and the total bulk may then be too much for the animal.

The effect of rainfall is not generally appreciated. In many districts the winter rainfall may be of the order of 20 inches, and an uncovered silo 20 by 45 feet will take in over 9,000 gallons of water. I have often found the feeding value of dry silage from a roofed silo to be twice that of wet silage from an uncovered one, though both were filled with the same material. For the average cow, around 100 lb of good silage should be adequate for maintenance and the production of 2 gallons of milk, and if all our cows were fed on silage to this level what a profound influence it would have on both the individual and the national balance sheet for milk production. All the signs are that from now on the simple laws of economics will force dairy farmers to set their sights on this target.

It is unlikely, however, that all the silage on a farm in any one year will be of such high quality, for this involves providing the requisite sequence of grass growth and having men and machines to deal with the grass at the critical stage of growth and in the least possible time. Most of us produce some silage each year which, by reason of being more mature when cut, is better for feeding to dry or young stock, and the evidence seems to indicate that perhaps this medium quality silage is the right type to provide for the fattening animal.

As for the total amount to be produced, much depends on the acreage of the farm, the layout, whether or not kale will be used to supplement the

grass, the number of followers carried, and so on. A reasonable target for dairy cows and fattening cattle is 100 lb for a period of 112 days or 5 tons a head. We have fed South Devon cows 150 lb per head per day throughout the winter and secured maintenance and 4 gallons of milk with no other foods, but this is exceptional and few farmers could provide so much silage for all their stock. Young stock will need amounts in proportion, and calves born during the winter months should be offered silage as early as possible.

Cheap and simple when cows help themselves

As with the fresh grass, so with silage: if the cows help themselves, this is the cheapest and simplest way of feeding them. So the College pioneered self-feeding and was one of the first farms in the country to have specially designed buildings erected for the purpose, using dehorned Guernseys. At the end of our third winter of self-feeding, we are quite convinced of the soundness of the system. Cows housed in the traditional manner require approximately 140 man-hours per cow per year. In the self-feeding yards the comparable figure is 80 hours per cow per year—a saving of 60 hours, or around £10 per cow. The cows have never been fitter; we have produced more muck, which will in due course result in higher fertility on the College Farm and, perhaps even more important, the cowmen are well satisfied with the system. By putting up self-feeding yards and a milking parlour combined, we have been able to site the buildings strategically in the centre of the leys. This not only facilitates grazing and minimizes the amount of travel necessary twice a day with the dairy herd in summer, but it also allows the use of the buckrake as the principal gathering tool for the silage. Our figures show conclusively that for distances of up to ¾ mile the buckrake gives the greatest output. Even for greater distances it is the cheapest and simplest means of gathering grass for ensiling.

Now what about the beef animal? Recently the College has acquired a herd of Devons, which will be maintained as a self-contained herd out of doors all the year round in the traditional manner; only grass, supplemented in winter by grass silage, will be available. Steers and heifers not needed for breeding will be fattened and will run with the herd. Thus we hope to secure figures relating to the cost of beef production on grass and grass silage. The work has only just started, and so, unfortunately, cannot be commented on at the moment.

For beef production too

The work of Morrison and Stephenson in Northern Ireland[1] and Dodsworth and Campbell in the north of Scotland[2] has shown the potential of silage for beef production. Dodsworth secured daily liveweight gains of 2·50 lb with Angus × Shorthorn and Galloway × Shorthorn cattle fed high quality silage to appetite. The dressing percentage was 60·29, and the average consumption of silage ranged from 61 to 100 lb. Morrison with beef Shorthorns showed gains of 2·4 lb per head per day on silage alone, the animals consuming an average of 114 lb per day.

During recent years the much greater potential profit to be obtained from milk in contrast with beef production has tended to emphasize unduly the

value of silage in the diet of the dairy cow. Now that beef is coming into its own and milk production is less attractive, the balance is likely to adjust itself, and I foresee much more research being carried out on silage for beef production and many more farmers feeding silage to their fattening stock. A recent report from the West Riding of Yorkshire[3] gives the figures for one farm where Hereford bullocks were self-fed on silage for eight weeks in 1958, receiving in addition hay, straw and some cereals. They consumed from 60 to 75 lb silage and put on approximately 2 lb live weight per day, were fit and in better condition than when roots were fed.

Morrison records an interesting feeding trial in 1956–57[4] when self-feeding was compared with trough-feeding of silage. The bullocks received silage only, and consumed from 100 to 120 lb per head daily. It was excellent silage, with 15 per cent crude protein and 23 per cent dry matter. The self-fed group averaged 2·04 lb liveweight gain per day, compared with 2·48 lb for the trough-fed animals. Another important point was that the labour requirement was particularly low, and even the trough-fed cattle needed only twenty minutes additional time daily.

It is evident from these results that not only has good silage a high food value for fattening cattle, but when self-fed, offers even greater advantages. Some planning of the buildings and the technique for self-feeding will be necessary in each individual case, but the British farmer has never lacked ingenuity.

Silage for sheep

Silage also plays an important part in feeding our ewe flock, the ewes receiving 10–12 lb per head per day from early December until spring grass is available in March. Frequently, of course, silage forms the sole food. It is fed in hay-racks, which give some protection from the rain—a most important point. It is also important with sheep, as it is with cattle, to clear away any uneaten silage before it moulds and is rejected. Even more important is to feed only the best silage to sheep—silage produced from young grass of high quality, well fermented and above all of high dry matter content. Ewes so fed have kept a clean bill of health, lambed down easily and milked well. On the other hand, the results with fattening hogs have been variable, and a great deal more work is necessary in this field. There is no apparent reason why the practice should not be successful and, as with fattening cattle, now that more interest is likely to be taken, more experience will quickly be gained and a suitable technique perfected.

The purpose of this article has been to outline our own experience at Seale-Hayne and to summarize some of the outstanding results of others in making silage the kingpin of the winter ration for cattle and sheep. There is great scope; we are only on the fringe of the possibilities that silage offers, particularly with the exciting new equipment for silage-making coming on to the market, which is likely to make it more attractive than ever as an economic feedingstuff. But if you have not made silage before, do seek help and advice. Work with your District Advisory Officer—he will enjoy helping you. Silage enthusiasts in your locality will be flattered if you seek their advice, and to visit a silage demonstration will not only be exhilarating; it could also be very profitable.

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Milking Parlours

Types, Performance and Selection

P. A. CLOUGH, B.SC.

National Institute for Research in Dairying, Shinfield, Reading

Cutting out unnecessary work in milking parlours is being looked at closely. Mr. Clough discusses the factors which affect the performance of the milker and milking units in different kinds of parlours and suggests how the most suitable type can be selected.

THE two basic types of milking parlour have either one or two stalls per milking unit. They can be classified according to the arrangement of the stalls and whether the cows stand at the same level as the milker, or higher. In the abreast layout, the stalls are side by side and may be at the same level as, or 8–24 inches higher than, the milker's work area. Cows enter the parlour through a door in the wall facing the stalls, and cross the work area to reach them. In the tandem layout the stalls are placed end to end on one or both sides of the work area and are normally raised 30–36 inches. A door at one end of each line of stalls enables the cows to enter them without crossing the work area.

There is evidence that the milker uses 50 per cent more energy to milk cows when they stand on his own level than when they are 32 inches higher. A difference in floor levels of 32 inches is practical in tandem parlours. In abreast parlours cows may climb one or two steps to enter a stall, but the provision of more than one step divides the work area, and since it appears that half stooping is just as tiring to the milker as squatting, two steps are not worth while. A single step of 8–16 inches does not inconvenience the milker and it prevents a cow from moving about during milking.

To limit walking distance, an abreast parlour should not contain more than six stalls per milker, and there should not be more than three stalls on either side of a tandem parlour.

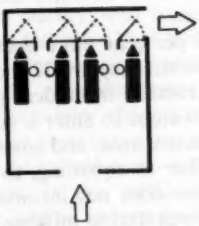
A manger and feeding equipment at each stall permits individual concentrate feeding during milking. Udder washing equipment and a fore-milk strip-cup must be provided at each milking unit, and in two-level tandem parlours should be fitted 28–36 inches above the floor of the operator's pit. Where a milking parlour is to be fitted in an existing building, an abreast layout may be the only possibility. The dimensions and levels of a new

Fig. 1 Basic type

One man operated parlour

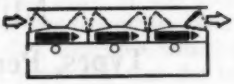
Abreast

(a) 3 stalls 3 units

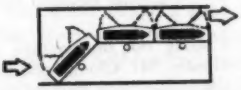


(b) 4 stalls 4 units

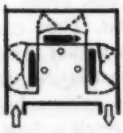
Tandem



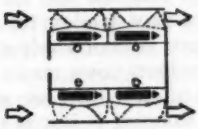
(c) 3 stalls 3 units in-line



(d) 3 stalls 3 units 'L' shaped

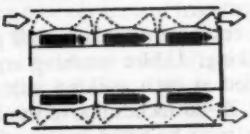


(e) 3 stalls 3 units 'U' shaped



(f) 4 stalls 4 unit double tandem

Two man operated double tandem



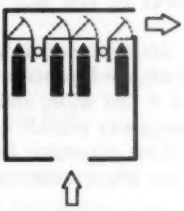
(g) 6 stalls 6 units

Fig. 2

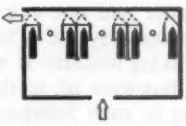
Basic type

One man operated parlour

Abreast

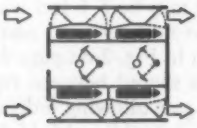


(a) 4 stalls 2 units abreast



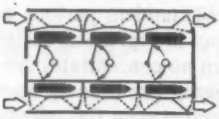
(b) 6 stalls 3 units abreast

Tandem



(c) 4 stalls 2 units double tandem

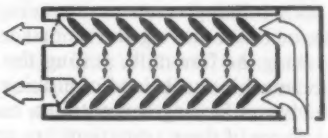
(d) 4 stalls 2 units chute



(e) 6 stalls 3 units double tandem

(f) 6 stalls 3 units chute

Two man operated parlour



(g) 16 "stalls" 3 unit herringbone

Key

Cows

Direction of movement of cows through parlour

Milking unit

building can be arranged to suit a two-level tandem layout, and it can be sited to allow easy entry and exit.

Milking parlour layout

One-stall-per-unit parlours The details of the layout of one-man operated milking parlours are given in Fig. 1 on page 112.

The stalls in a three-stall three-unit tandem parlour may be set in line, or in the shape of an L or U. In a "four-stall four-unit" parlour, two stalls are placed on each side of the pit, and entrance and exit doors are provided for each line of the stalls. For two milkers, three stalls are set in line on each side of the operator's pit, and each milker works on one side of the pit, which may be 5–6 feet wide (Fig. 1a).

Two-stall-per-unit parlours Abreast and double-tandem layouts are shown in Fig. 2 on page 113. In normal double-tandem layouts each milking unit is shared between two stalls across a pit 4–5 feet wide, and each stall has a gate allowing independent access to a passageway outside each line of stalls. A building 15–16 feet wide is necessary. Less expensive forms of the double-tandem parlour have been designed for use where cows are moved in and out of the parlour in batches.

In chute parlours (Figs. 2d and 2f) the walls of the building form the outer sides of the stalls, and the divisions across the front and rear of the stalls slide inwards over the pit when a batch of cows is changed. This layout can be fitted into a building 10 feet wide.

The herringbone layout enables 6–10 units to be managed in a two-level double-tandem parlour having only one entrance and one exit door. The layout in Fig. 2 was designed for large herds managed by one or two milkers, when no concentrates are fed and a pipeline milking machine is used. It has a zigzag bar running above each side of the 4-feet-wide pit so that the distance between the udders of the cows standing in each 5-feet-wide race is only 3 feet, compared with the 7½–8 feet between them in the other double-tandem layouts.

Before assessing the comparative performance of different milking parlours, one must decide what operations are essential, and how the two main types of parlour affect the milking routine and the performance of the milker and milking units. During milking, the milker's time is spent repeating a regular sequence of operations for each cow and doing occasional jobs not directly concerned with milking, such as attending to milk cooling. The routine for each cow includes moving the animal into and out of the stall, washing the udder, taking the fore-milk, putting the teat-cups on, and stripping and removing the machine at the end of milking. Other operations, such as recording milk yields and feeding concentrates, may take place and stripping may be omitted. Some of these operations are unavoidable: others, such as the stripping, are considered necessary to maintain milk yields. Udder-washing and the removal of fore-milk are demanded by the Milk and Dairies Regulations.

A limited number of time studies of the work routines practised in existing one- and two-stall-per-unit parlours have shown that 110 seconds is spent on each cow, the time being divided as shown in Table 1a. More recently, extensive investigations have been carried out by the Work Study Unit of

the I.C.I.'s Central Agricultural Control, and the standard times in Table 1b have been proposed for one-stall-per-unit parlours. Table 1c shows actual operation times recorded in a four-stall two-unit parlour. The shorter work routine times of 86 seconds (Table 1b) and 98 seconds (1c) are due mainly to reductions in machine stripping time compared with work routine (1a). By omitting machine stripping, work routine (1a) is reduced to 70 seconds per cow.

Table 1
Basic Work Routine

(a)

One stall-per-unit	Time in seconds	Two stalls-per-unit	Time in seconds
Machine strip	40	Machine strip	40
Remove and hang cluster	10	Transfer unit to next cow	20
Change cows	20	Change cows	20
Wash and fore-milk	30	Wash and fore-milk	30
Put on unit	10		
Total	110	Total	110

(b) One stall-per-unit

	Time in seconds	
Read and reset balance	4·8	}
Prepare unit	6·0	} 19·2
Put on cups	8·4	}
Record yield	6·0	}
Change cows	7·2	} 20·4
Feed concentrates	7·2	}
Wash and fore-milk udder	21·6	
Sub-total	61·2	
Machine stripping	24·6	
Total	85·8	

(c) Two stalls-per-unit

	Time in seconds	
Read and reset balance		}
Transfer unit		} 23·4
Put on cups		}
Record yield		}
Change cows		} 25·8
Feed concentrates		}
Wash and fore-milk udder	23·4	
Sub-total	72·6	
Machine stripping	25·2	
Total	97·8	

Table 1b shows the standard times prepared by an I.C.I. work study team
1c shows actual times recorded by the N.I.R.D.

The way in which the basic routine is carried out depends on whether each milking unit is confined to a single stall or shared between two. For example, in a three-stall three-unit parlour the interval between putting the teat-cups on a cow and returning to machine strip will be twice the work routine time (that is to say, 2×110 seconds). This type of parlour restricts the use of each milking unit because the unit is idle for about 70 seconds between cows while all the work routine except machine stripping is carried out.

In a parlour having two stalls per unit, the milking machine is out of use between cows for only about 20 seconds, but in the interval between putting the teat-cup on a cow and returning to machine strip, a full work routine is carried out at the other units and, in addition, the milker prepares the cow in the paired stall. The time taken to complete this round of work in a six-stall three-unit parlour is $110+110+50=270$ seconds.

In chute and herringbone parlours, cows are not moved singly in and out of the stalls. When all the milking units are in use on one side of the parlour, all the cows on the other are changed.

Concentrate feeding in the parlour

The rate at which cows will eat dry concentrates has not been fully investigated, but trials have shown that the average is about ¾ lb per minute. The quantity of concentrates eaten during milking in a one-stall-per-unit parlour will not exceed 5 lb — ¾ × milking time + routine time—but in a two-stall-per-unit parlour, up to 7½ lb may be eaten while each cow is in a milking stall. In columns 4 and 9 of Table 3 the maximum quantities of concentrates likely to be eaten are shown.

The work routine limits the number of cows which may be milked per hour. The theoretical maximum is reached when the milker is fully occupied with routine work, and it is calculated by dividing the routine time per cow into 60 minutes. To prevent the over-milking of some cows and to allow enough time for the milker to attend to non-routine jobs and maintain a good performance, the milker should spend not more than 85 per cent and not less than 70 per cent of his time on routine operations. The theoretical performance of a milker occupied for 100, 85 and 70 per cent of his time with routine operations when routine times per cow are 110, 96, 84 and 70 seconds are shown in Table 2.

Table 2

	Per cent of milker's time on routine work		
	100	85	70
Routine time per cow	Cows milked per hour		
sec			
110	33	28	23
96	38	32	26
84	43	36	30
70	51	43	36

The number of milking units required will depend on the average machine milking time of the herd and the range of milking times of the individual cows. The milking rate of a cow will be determined by the effective size of the teat orifices and her current milk yield: it is likely to be about 3 lb per minute. Variations due to different milk yields are likely to give the time/yield relationships shown in Table 3. The average milking rate of a herd can be increased to 4–5 lb per minute by culling inherently slow milkers and operating the milking machine at a higher vacuum, with wide ratio pulsations.

With the times given in basic work routines in Table 1, it is possible to calculate the theoretical performances of the various types and sizes of parlour (Table 3). These are not absolute because the duration of the routine work is never constant, neither can the identical milking times assumed in the calculations be achieved. The data in Table 3 indicate that a milker may operate 2–5 units efficiently. In two-unit milking parlours a work routine time per cow of up to two minutes will allow 20 or more cows to be milked per man-hour, if the milker is at least 70 per cent occupied with routine work. To enable a milker to operate 3, 4 or 5 units, when the average machine milking time does not exceed 6 minutes per cow, the work routine time per cow should not exceed 105, 90 and 75 seconds respectively.

Table 3

Performance of one-man parlours

No. of units	ONE-STALL-PER-UNIT LAYOUTS					TWO-STALL-PER-UNIT LAYOUTS				
	Machine milking time (*mins/cow*)	Milk yield (*lb/cow*)	Max. concentrates fed per milking (*lb/cow*)	Cows milked *per hour*	Per cent of milker's time	Machine milking time	Milk yield (*lb/cow*)	Max. concentrates fed per milking (*lb/cow*)	Cows milked *per hour*	Per cent of milker's time
Work routine time 110 seconds per cow										
2	3	8	3½	25	76	3 4½	8 14	5 7½	30 22	93 67
3	4½ 6	14 20	4½ 6	28 23	87 70	6	20	10	26	79
Work routine time 70 seconds per cow										
3	3	8	3	43	84	4½	14	7	37	72
4	4½	14	4	42	82	6	20	9	38	74
5	6	20	5½	42	81	6	20	9	47	90

Selecting a parlour

If the following details are known, they can be used in conjunction with the data in Tables 1 and 3 to select a suitable parlour for a particular farm.

1. *Total number of cows in the herd and the calving policy*

This will allow a sensible estimate of the number of cows to be milked.

2. *Expected lactation yield per cow*

The average daily yield per cow may be calculated by dividing the average annual yield by 300; it will indicate the average machine milking time per cow.

3. *Daily time allowed for machine milking*

The time the milking units are in use each day will, in many instances, decide the number of units and milkers required.

4. *Concentrate feeding policy*

Where concentrates are fed at milking, the quantity fed per cow is important in determining the type of parlour used. Sufficient feeding time must be available without restricting the utilization of the milking units.

5. *Operations to be included in the work routine*

The data in Tables 1 and 2 indicate the approximate times needed for different operations and show how the work routine time per cow affects the performance of the milker.

A guide to the selection of a parlour for stated management conditions is shown in Table 4.

TABLE 4

Selection of one-man operated parlours when average lactation yield is less than 1,000 gal/cow and twice daily milking requires about 3 man-hours/day.

Quantity of concentrates fed/cow /milking	Work routine time less item sec/cow	Number of cows in herd: 10 20 30 40 50 60 70 80	Parlour type
None or 3-5 lb	120	2 stall 2 unit	
	105	3 stall 3 unit	Abreast or tandem
	90	4 stall 4 unit	
	75	5 stall 5 unit	Abreast
None or 4-9 lb	120	4 stall 2 unit	Abreast or tandem
	105	6 stall 3 unit	
	90	8 stall 4 unit	Herring-bone
	75	10 stall 5 unit	

Both the three-stall three-unit and four-stall two-unit parlours are suitable for most herds. With concentrate feeding of less than 5 lb per cow per milking, the three-stall three-unit plant will allow more cows to be milked per

hour, but there will be more over-milking, particularly in late lactation and at afternoon milkings. Feeding of up to 7½ lb of concentrates per cow is possible in the four-stall two-unit parlour, where there is much less chance of over-milking and sufficient time is available for *thorough washing of dirty udders*. At afternoon milkings this parlour is likely to have a higher hourly throughput of cows than the three-stall three-unit layout. Either is suitable for herds of up to 40 cows with average lactation yields below 1,000 gallons per cow, milked twice daily and using a total of 3 man-hours a day.

Where it is necessary to milk 40–60 cows at a rate of 36–45 an hour, the milker must spend less time on the routine work of each cow. This can be done in a number of ways, but the best is probably to eliminate stripping.

For low-yielding herds, the three-stall three-unit parlour would be the most suitable. Where there are higher yields either a six-stall three-unit or four-stall four-unit parlour would suit, depending on the level of concentrate feeding.

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Dalapon for the Control of Grass Weeds

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A progress report on a new and very potent grass-killer which can be applied as a foliar spray without affecting many broad-leaved plants.

THERE has been a fourfold increase in ground-crop sprayers in England and Wales during the past five years; about 33,000 sprayers are now in use. Side by side with this increase there have been new chemicals for weed control and new ways of using old chemicals. Herbicides such as MCPA, 2,4-D, MCPB and, in the past year or two, CMPP, 18-15 and SMA have appeared on the commercial market to deal with many outstanding weed problems. Their characteristic high toxicity to broad-leaved plants and low toxicity to plants such as cereals has been the key to their success.

In contrast, there have been few major developments in the chemical control of grass weeds. Progress has been mainly restricted to extending the usefulness of the well-known herbicide TCA (trichloroacetic acid), which is now recommended as a pre-sowing treatment for the control of wild oats in sugar beet and peas as well as for the control of couch grass. TCA is absorbed only by the roots of plants, which means that it has to be mixed into the soil to be effective, and its weed-killing properties are markedly influenced by the soil type and by the rainfall following application.

A chemical that is proving very potent as a grass-killer and does not suffer these drawbacks because it is applied as a foliar spray is dichloropropionic acid, which has been given the common name dalapon. It was discovered in America in 1953, and found to be a very effective grass-killer when applied to the foliage of actively growing plants at doses of 5–40 lb per acre. In Great Britain, dalapon has been under test for several years, but it has not been available commercially and relatively little effort has been put into its development. Few results of the field testing of dalapon under British conditions have been published.

Properties of commercial dalapon (sodium salt)

Recently, dalapon formulated as the sodium salt* has become freely available in the United Kingdom. It is of particular interest because no other herbicide applied as a foliar spray is capable of killing grasses without affecting many broad-leaved plants. It must be emphasized that dalapon is still in the development stage and that firm recommendations cannot yet be made for many of its uses. This article has been written as a progress report for readers who may wish to try it.

The commercial grade of dalapon is an off-white powder which is readily soluble in water; in solution, the chemical gradually deteriorates at normal air temperatures. Mixing is best done by putting the powder direct into the sprayer with the agitator working. Dalapon (sodium salt) is a very safe chemical—less toxic than common salt when taken in single oral doses. The likelihood of humans, livestock or wild life suffering serious effects is, therefore, remote. The powder form can irritate the skin if it is allowed to remain in contact for prolonged periods, and it is capable of causing irritation to the eyes, though serious damage is not likely to occur. The manufacturers recommend that eye protection should be worn when handling the powder or concentrated solutions. Solubility is not affected by hard water, and dalapon can be applied at low and medium volume rates according to the amount of chemical being used. It is not corrosive to machinery and can be used in ordinary farm spraying machines.

When applied in sufficient quantity to perennial grasses, it can produce dormancy or death of crown and rhizome buds. Dalapon enters mainly through the leaf, but to a less extent through the soil and root system; after entry it is transmitted throughout the plant. Its effects are slow in developing; the external symptoms are usually stunting and die-back of top growth. Although it is better to spray when the shoots are growing actively, dalapon can be very effective in mild weather in autumn or early spring.

Effect on grass weeds

Grass weeds are a major problem in many different situations. The three most important annual species, annual meadow-grass (*Poa annua*), blackgrass (*Alopecurus agrestis*), and wild oats (*Avena fatua* and *A. ludoviciana*) are predominantly weeds of cropped land, where selective control is required.

* Sold under the trade name "Dowpon", which contains 85 per cent sodium salt of dalapon or 74 per cent acid equivalent plus a wetting agent. All application rates in this article are in 16 acid equivalent per acre.

Of the large number of perennial species, the couch grasses (*Agropyron repens, Agrostis gigantea* and *A. stolonifera*)* are of particular interest to farmers and growers in Great Britain, their control being required either in short fallows before planting or selectively in perennial crops and many long-term horticultural crops. Experimental work in the United Kingdom has tended to concentrate on the control of couch grass, and the precise dose of dalapon to kill any of the three annual grass weeds under various conditions is uncertain. Preliminary experiments with wild oats suggest that about 8 lb of dalapon per acre is required for 90 per cent or greater mortality when the plants are sprayed between the two-leaf stage and the fully-tillered stage, but smaller doses can cause a marked and useful inhibition of growth. The results of spraying couch grass with dalapon, although very encouraging, have been variable because of the complexity of the problem; several species and many agronomic and seasonal factors are involved. The problem is not so much will dalapon kill couch grass but rather what is the most economical dose for each situation, bearing in mind associated cultivations and cropping.

It seems that the minimum effective dose may vary from about 5 to 40 lb per acre, according to conditions and requirements; the lower limit sometimes suffices where treatment in arable land can be followed by practices that minimize regeneration of any survivors—for example, growing a "smother" crop such as kale. At the other extreme, dense stands of couch in uncropped areas may well require 20–40 lb per acre to secure eradication without the assistance of cultivation. Thus a single generalized recommendation cannot be correct in all circumstances. Farmers should ask their local N.A.A.S. officer before deciding to treat a large area. It also follows that where selective control of couch in crops is required and a low maximum dose of, say, 5 lb per acre is imposed by the tolerance of the crop or by economic considerations, variable results are likely to be obtained, according to the vigour and age of the infestation and the timing of the application.

Methods of use

For the control of couch between crops, there appear to be three methods of using dalapon. The most desirable from a farmer's point of view is probably the treatment of cereal stubble in the autumn, as this demands no check or modification in the rotation. In a dry season it may be necessary to wait several weeks after harvest before spraying, to allow sufficient couch foliage to grow; otherwise spraying can take place as soon as the crop has been removed. Satisfactory results can be obtained from spraying at any time during the autumn, but until more evidence is forthcoming it is advisable to carry out the treatment as soon as there is enough top growth. Ploughing, which should not take place for two to three weeks after spraying, is reported to help the eradication of couch, but it is not essential. When the field is to be ploughed immediately after harvest, treatment with dalapon must be postponed until the couch foliage has developed well on the furrow slices. There is no point in applying dalapon to the bare soil.

Another possibility is to spray as soon as the couch has made sufficient growth in the spring (probably in late April), after autumn or winter ploughing. Cultivations shortly after spraying are of doubtful merit on many soils,

* Couch and its Control. S. A. EVANS. *Agriculture*, **64**, 298–301.

because they tend to spoil the winter tilth or cause loss of moisture. Dalapon applied at 10–15 lb per acre persists in the soil at a concentration sufficient to damage crops sown within about six weeks of spraying; after this interval kale can be sown with little risk of injury and with the knowledge that a dense crop will do much to eradicate any surviving couch plants.

Unless dalapon is applied early enough to allow a late-sown crop to be grown successfully, treatment must either be put off until the autumn or the field fallowed for the summer. A conventional summer fallow cannot be relied upon to eradicate couch if the weather is unfavourable, and the labour requirement is often prohibitive. Dalapon has given very satisfactory results when applied between May and October, and there is no indication that timing of the treatment is particularly critical.

Cultivations before and after spraying can help the herbicide, but it remains to be shown whether it is more economical to use a higher dose of dalapon without, or a lower dose with, cultivations. In America it is claimed that improved results can be obtained by making two applications of half the normal dose at an interval of two to three weeks. Experiments are in progress to test this practice under British conditions.

These are some of the factors to be considered when using dalapon for the control of couch grass. Although undoubtedly the chemical is of great potential value, much more research is required before it can be used efficiently.

How crops react

The two agricultural crops that appear to offer most hope of a selective use of dalapon are the legumes, lucerne and white clover.

Lucerne has proved to be resistant to 5 lb per acre when the plants have little or no green top growth. Convenient times for treatment are in the autumn, after the lucerne has died back but while the grasses are still showing a little growth, or in the early spring before the lucerne shoots have begun to grow. Applications of this type have increased yields of grass-free lucerne during the growing season following spraying. But it cannot be expected that the lucerne will remain uninfested for many years, because it provides a very poor ground cover in winter and allows the gradual re-establishment of grasses. If a lucerne crop contains established broad-leaved perennial weeds as well as grasses, the removal of the grasses may well lead to an increase in the broad-leaved weeds.

In an experiment on a pure crop of S.100 white clover, dalapon was applied at various rates up to 4 lb per acre; the 4 lb treatment had an initial depressing effect, but one month after spraying the clover returned to normal and no significant reduction in growth was found in a cut taken a month after this. The results of similar work on broad red clover showed that it was less tolerant than white clover; 2 lb per acre was the maximum dose that did not reduce the cut two months after spraying.

As dalapon can be taken up by the roots of plants as well as through the leaves, its persistence in the soil has to be taken into account when a crop is to be planted after spraying. The amount of chemical applied, the time interval and weather between spraying and planting, and the resistance of the following crop, all help to decide whether damage will be done. In general, a high dose will persist longer than a low one, dry cold weather

causes longer persistence than wet warm weather, and a susceptible crop requires a longer time than a more resistant one between spraying and planting. It follows that we cannot say dogmatically how long dalapon will contaminate the soil sufficiently to affect a following crop. The range of effect seems to vary from a satisfactory establishment of kale sown three weeks after spraying dalapon at 5 lb per acre to considerable damage to spring barley sown six weeks after spraying 10 lb per acre.

Susceptibility of young annuals and established perennials to a foliar spray of dalapon

(The groupings are based on unpublished preliminary work in the United Kingdom and are necessarily approximate.)

Susceptible to 5 lb per acre (acid equivalent)

Red clover	Cabbage
Timothy	Oats
Cocksfoot	Wheat
Perennial ryegrass	Barley
Italian ryegrass	Maize
Peas	Potatoes
Parsnips	Sunflower
Kale	Oil-seed poppy
Field beans	Creeping fescue (*Festuca rubra*)
Turnips	Crested dogstail (*Cynosurus cristatus*)
Onions	Bents (*Agrostis* spp.)
Carrots	Rough stalked meadow-grass (*Poa trivialis*)

Susceptible to 10 lb per acre

Lucerne	Couch grass (*Agropyron repens*)
White clover	Meadow buttercup (*Ranunculus acris*)
Sugar beet	Wild oat (*Avena* spp.)
Yellow oat (*Trisetum flavescens*)	Blackgrass (*Alopecurus agrestis*)

Resistant to 10 lb per acre

Autumn hawkbit (*Leontodon autumnalis*)	Bulrushes (*Typha* spp. and *Scirpus lacustris*)*
Plantain (*Plantago lanceolata*)	
Creeping cinquefoil (*Potentilla reptans*)	Bur-reeds (*Sparganium* spp.)*
Bulbous buttercup (*Ranunculus bulbosus*)	Yellow flag (*Iris pseudacorus*)*
Daisy (*Bellis perennis*)	Sedges (*Carex* spp.)*
Creeping thistle (*Cirsium arvense*)	Soft rush (*Juncus effusus*)*
Dandelion (*Taraxacum officinale*)	Orache (*Atriplex patula*)
Bracken (*Pteridium aquilinum*)*	Speedwell (*Veronica persica*)
Reed (*Phragmites communis*)*	Annual nettle (*Urtica urens*)

* Susceptible to 20–40 lb per acre.

Other uses of dalapon

The more obvious uses for dalapon have already been mentioned, but there are many others to which the chemical might be put. The control of emergent aquatic plants that have invaded drainage ditches and shallow lakes or ponds is at present laborious and expensive. Limited experience shows that dalapon can kill many of the most important species at doses of 20–40 lb per acre (see the table above). Bracken has successfully resisted eradication by economic doses of herbicides in the past. In a preliminary trial started in August 1956, spraying with 10, 20 and 40 lb dalapon per acre resulted in 42, 72 and 92 per cent reductions respectively of bracken fronds

a year later. The results were sufficiently promising to merit a series of experiments in co-operation with the N.A.A.S.

In farm practice it is fairly easy to alter the grass/clover balance of a sward in favour of the grasses—indeed nitrogenous fertilizers, hay and silage often bring this about when it is not wanted—but the reverse process of increasing the clovers is not so easy. A low dose of dalapon mixed with 2,4-DB and applied at the right time would selectively check the grasses and broad-leaved weeds so as to allow white clover to come away, and might well be useful in pasture control or in a white clover seed crop containing an undesirable quantity of grass. However, it must be remembered that dalapon is depressive to the grasses rather than directly stimulating to the clover, and this would be a drawback where total yield of herbage is a primary consideration. Further critical examination of its effect on the growth and seed yield of white clover will also be necessary before any practical recommendation can be made.

The plough has in the past been considered essential to the breaking up of old swards for cropping or reseeding; by inverting the furrow slice it kills the old turf and at the same time exposes a clean surface of the soil for the implements that follow. But ploughing needs a lot of power, and can be difficult or impossible on steep, wet or stony land. On such land, there might well be a use for a mixture of chemicals that would destroy the old sward without ploughing, and thereby permit surface cultivations for a seedbed. Research has been in progress for two years in co-operation with the Grassland Research Institute on the effectiveness of dalapon, and other chemicals, for this purpose. The first pilot experiment, started in 1956, involved autumn spraying followed by spring reseeding; it was successful and is being followed up in other experiments that cover a wider range of treatments and conditions.

Stimulant to research

Hedge bottoms and the sides of ditches usually harbour annual and perennial weeds that can spread into the field which they surround. Particularly troublesome in this respect are the grasses, especially couch grass, which may be ploughed into the field when the ploughman tries to get close up to the hedge or ditch; their roots are spread into the field by the cultivations that follow and can become a serious infestation that could easily have been controlled at source. The absence of suitable chemicals for grass control has held back the clearing of unwanted vegetation from the sides of fields: dalapon should stimulate research in this direction.

There are many other situations which do not come within the scope of this article, where an effective grass-killer is required—particularly in market gardens, orchards and forests. It remains to be seen where and when dalapon will fit into the British farming pattern, because apart from the technical developments that have been discussed, the cost of the chemical will decisively influence acceptance on the farm.

Nevertheless a new impetus has been given to the chemical control of grass weeds.

Pastures for Pigs

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Young, quick growing legumes and leafy grasses make the most nutritious grazing for pigs, and they can show a large saving in meal, especially in the final stages of fattening and during pregnancy.

Pigs can eat only a small quantity of bulky foods; consequently, to obtain the maximum benefit from grazing, highly nutritious herbage should be offered. The fibre in young, quickly growing herbage is less woody, and probably more digestible, than that in slowly growing herbage at the same stage of growth. Therefore pasture management should aim at producing a young, leafy and vigorous sward.

Pigs must be allowed to graze selectively, so that they can choose young leaves and reject fibrous stems. They can do this best when given free range at a low rate of stocking.[1] Pigs cannot obtain much benefit from grazing when kept in small muddy pens, or in fold units, even if they are moved daily. The amount of herbage available is severely restricted and its palatability quickly reduced by soiling. If it is necessary to control the pig herd, then frequent moves to fresh pasture (by using an electric fence or, in the case of sows, a long tethering chain and harness) are preferable to the use of fold units.

Eyles and Alder[2] noticed that pigs graze white clover in preference to the grasses: it has more leaf and less fibrous stem, especially at maturity. In addition, it thrives under managements which keep pastures short and young, and it is easier than the grasses to keep leafy throughout the growing season. Unfortunately, a pure sward of white clover is usually invaded by aggressive indigenous grasses. For instance, at this Institute, during the period from April to December 1956, the percentage of white clover was reduced from 72 to 40 by the grazing of two ringed sows and suckling litters per acre, plus occasional sheep grazing. During the same period, unsown grasses (particularly perennial ryegrass, Yorkshire fog and rough-stalked meadow-grass) increased from 15 to 40 per cent. When used for pig pastures, white clover should be sown with a leafy pasture strain of grass, such as S.23 perennial ryegrass, S.48 timothy, or S.53 meadow fescue. Suitable seeds mixtures are suggested in Table 1. The use of cocksfoot, even the S.143 strain, is not advised because it must be kept in a very short, young condition and prevented from flowering. This high standard of pasture management is often impracticable on the ordinary farm. Chicory grows quickly and must be grazed young, when it provides palatable herbage of low fibre content.

Taking pigs round the farm

It is impossible to discuss pig grazing without dealing with the problem of pigs rooting the pasture. Either rooting is allowed and the pigs confined

to pastures due for ploughing, or it is prevented by ringing. Permissible rooting is suitable for the general farm, where pigs are taken round the farm and graze the last year of long leys or one-year leys of Italian ryegrass and red clover. Under these conditions, rooting and winter puddling of pastures do not matter, and the pigs are distributing their manure, which will be utilized by the following arable crop. Moreover, the pigs will have clean land, free from parasites, each year.

Table 1

Seeds mixtures for pig pastures

(*Seed rates in lb per acre*)

		Mixture number			
		1	2	3	4
Perennial ryegrass	S.23	6	12	—	—
Timothy	S.48	—	6	2	—
Meadow fescue	S.53	—	—	3	3
White clover	S.100	4	3	2	—
" "	S.184	1	—	2	¼
Lucerne	Du Puits	—	—	—	15
Chicory		—	—	6	—
	Total	11	21	15	18¼

On a small pig holding where land is severely limited, or where the pasture is grazed by cattle and sheep, the pigs must be ringed. The damage done by rooting is illustrated by the experience gained at the Grassland Research Institute. After six months' grazing of young swards by unringed sows and porkers, there was 44 per cent of bare ground, against only 9 per cent when grazing was by ringed pigs. Piglets start rooting at 6–7 weeks of age, and therefore should be ringed at weaning. For growing and fattening pigs, double rings stay in the snout much longer than single ones; the latter are pulled out of the nose when caught on wire-netting fencing. Small copper "bull rings", inserted through the gristle of the septum dividing the nostrils, are most suitable for breeding stock. These "bull rings" have been most satisfactory in preventing rooting by sows and, except for occasional accidents, have lasted the breeding life of the sows without interfering with their grazing or other activities.

If the sward is to carry pigs throughout the year, their number per acre must be kept fairly low (that is, 12–20 growing-fattening pigs, 3–4 pregnant sows, or 2–3 lactating sows), and during spring, excess herbage should either be grazed by sheep and cattle or cut for silage. Both the pasture and the pigs benefit from rotational grazing; the frequent rests allow the sward to recover from grazing, while the risk of building up parasitic infection in the pigs is minimized. A suitable management during the growing season would be a combination of rotational sheep grazing and gang-mowing two to three weeks in front of the pig herd; at least four paddocks should be used, the pigs spending one week in each in turn.

Suitable swards

The best-wearing herbage species is one that produces a closely-knit turf which will not puddle in winter and will colonize bare ground quickly in the spring. A persistent sward can be maintained by imposing good manage-

ment on a pasture strain of grass which thrives in short, dense swards. At this Institute, a sward formed by sowing 20 lb of S.23 perennial ryegrass per acre was very durable (Table 2). The contribution of S.23 increased even

Table 2

Changes in botanical composition (per cent area cover) of a pure S.23 perennial ryegrass sward caused by pig grazing during the first two harvest years*

Sward management	Date of analysis	Perennial ryegrass	Unsown grasses	Bare ground
Grazed by unringed sows	April, 1955	73	16	8
Rested	Oct., 1955	82	8	9
Grazed by ringed sows plus sheep	April, 1956	81	14	0
	Dec., 1956	84	16	0

* The remaining percentage is other weeds.

after one season's grazing by unringed sows. In 1955 there was a three-month drought, during which the pastures made little recovery growth after the June topping. Rooting by the sows occurred only in the autumn after heavy rains, and possibly was induced by the previous lack of lush herbage. In the second year, ringed sows continued grazing right through to December without causing a reduction in the content of perennial ryegrass. Although S.50 timothy has not been tested under pig grazing, it is persistent under poultry grazing, and is likely to be a suitable strain for pig pastures because of its excellent turf-forming capacity. If grazing is to replace part of the meal ration, a continuous supply of succulent herbage must be planned for the whole year. Special provision has to be made to alleviate scarcity of herbage on ordinary grass and white clover swards during summer drought and winter.

Lucerne

Of all pasture plants, lucerne withstands lack of moisture best and even produces new growth during a drought. If allowed range grazing on lucerne, pigs eat the young shoots and leaves, rejecting the fibrous stems. The pigs are selecting the most nutritious parts, but the continual removal of these young shoots weakens the plants. The great majority of lucerne strains available in Britain are erect types intended for cutting for hay or silage, and these are killed out by frequent cutting or grazing when young.

In a good stand of Ile de France lucerne/S.215 meadow fescue/S.100 white clover grown at Hurley, the percentage of lucerne was reduced from 91 to 17 by three years of grazing with ringed pigs. It was mainly replaced by meadow fescue and white clover, which increased from 5 to 52 and from 2 to 20 per cent respectively. This reduction of lucerne occurred in spite of good grazing management and resting the sward for a silage cut once each year. A similar stand, after three years of grazing by unringed pigs, contained negligible amounts of lucerne, 25 per cent of meadow fescue, 48 per cent of unsown grasses and 20 per cent of weeds. Annual meadow-grass,

mayweed and knotgrass were the principal species which had established themselves in this sward.

Thus if a lucerne sward is to be maintained, pig grazing must be confined to the summer drought period and the stand cut for hay or silage in spring and autumn. When lucerne is grown mainly for pigs it should be sown with 2–5 lb per acre of a companion grass, like meadow fescue, and ½–1 lb per acre of white clover (see Table 1). The grass and clover will increase in the sward as the lucerne dies and so help to stop the incursion of weeds.

The provision of an abundance of green digestible leaf during winter is a more difficult problem. Some farmers now grow crops of kale, rape and fodder spinach especially for pig grazing in winter, but these make no recovery growth. Among the grasses, Italian ryegrass makes the most of mild spells in winter to produce new growth. When the weather is unsuitable for grazing, good silage made from *very young* leafy spring grass can be fed to sows, or high levels of dried grass mixed into their meal rations.

Saving of meal by grazing

Adult pigs can make use of larger quantities of herbage than can young pigs. Eyles and Alder[1] have suggested gradually increasing the proportion of the total diet supplied by herbage from nothing at weaning to 30 per cent during the final stages of fattening bacon pigs. Although not replacing meal, the small quantity of herbage eaten by sucking piglets is beneficial. Barber, Braude, and Mitchell[3] have shown that litters reared on pasture thrive better and eat more creep meal than those reared inside and regularly injected with iron. Recent work at the Grassland Research Institute[4] suggests that access to grazing allows meal to be saved during the first thirteen weeks of pregnancy without affecting farrowing results. Sows receiving normal meal rations became fatter than those fed reduced meal rations.

Many farmers firmly believe in the beneficial value of grazing for pigs, particularly breeding stock,[5] but there is a lack of scientific evidence on the best way of exploiting pastures for pigs.

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Zero Grazing of Dairy Cattle

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Zero grazing is the modern term for the old practice of soiling. Experiments at the University of Edinburgh dairy unit suggest that there may be much to be said for taking grass to the cows instead of the usual grazing.

ZERO GRAZING is a system of feeding in which grass is cut and carted to dairy cows housed in yards and paddocks. Silage is interchangeable with fresh grass, and in parts of the U.S.A. it is fed all the year round. There is nothing new about the system, which is aimed at increasing the intensity of grass management by improving the efficiency of production. It is based on the old British and European practice of soiling grass, which in Britain has died out, since it involved so much hand labour. Renewed interest in it has returned from America through recent developments in mechanical forage harvesting and handling. At first it was used only in irrigated areas to make the maximum use of forage produced on irrigated pastures, but latterly it has spread to other parts of the States.

The advantages claimed for zero grazing are: improved utilization of the grass crop, increased production per animal, better use of land, simplified farm layout and fencing, and control of bloat. Damage to pasture swards by treading, dunging and urinating is avoided—it has been estimated that 20 per cent of grass may be so wasted (droppings alone may cover 10 per cent)—although intensive use of an electric fence and the alternate cutting and grazing of pastures can, of course, reduce these figures. The selective grazing by animals is avoided when stem and leaf are cut together. Increases in output of 20–30 per cent have been estimated where zero grazing has been introduced in America.

There is evidence in the United States of an increase in milk production per cow when grass is fed in yards. The animal expends little energy in obtaining her feed and thus more is available for production. Zero-grazed animals also put on greater weight during the summer months than those out grazing.

Land utilization is improved because a smaller acreage may be required to maintain the same number of animals, or more milk can be produced on the same acreage. The surplus acreage can keep more cows or produce more cash crops.

The need for water supplies and fencing in all fields is removed, and fields distant from the steading and previously inaccessible to the dairy herd can be used for feeding. This allows a more balanced rotation with grass leys to be practised all over the farm.

The incidence of bloat has been reduced, since selective grazing by the animal is prevented. When material likely to cause bloat has to be fed, the quantity offered can be reduced and a more fibrous supplement provided. Grass quality is easier to control by cutting than by grazing, and there appear to be less day-to-day variations in milk yield than under certain

grazing systems. The disadvantages of the system are that the feed must be harvested daily and in all kinds of weather, increased operating and equipment costs are incurred, cattle housed indoors require more attention than those out grazing, more straw is needed for bedding, and the intensity of production is increased, which means that additional management worries may arise.

It is unlikely that there will be many days when the grass cannot be cut, but this depends on soil conditions and rainfall. The damage to wet pastures is not likely to be greater than that caused by animals grazing. There may, however, be some discomfort to the men involved. If the grass cannot be harvested, then some succulent substitute must be available: the feeding of silage made from grass of similar quality to that fed green causes no apparent drop in milk production.

Equipment

Efficient machinery is essential for this system—a forage harvester and, ideally, a self-unloading trailer to deliver grass directly into the troughs. The cost of operating a forage harvester depends on the number of hours worked during the season. Where silage is made, operating costs are reduced. If the dairy staff can cut and feed the grass, the expense is further reduced, but it may be more convenient for the arable staff to cut the grass and the dairy staff to feed it. This allows the forage harvester to be used continually by one man—a very important factor in its satisfactory maintenance. The machinery must be reliable, and some alternative method of cutting the feed is necessary when breakdowns occur. The presence of a second harvester puts up costs. The simpler the machine, with the minimum number of moving parts, the less likelihood there is of a breakdown and the better it is for this system.

The time required to move cows to and from pasture and to move electric fences (which may easily be 1½ hours a day) can be set against the time required to feed the grass. The yards where the cattle are housed will have to be cleaned: the time this takes will vary with the system, and with mechanical aids it may be very small.

The straw needed for bedding will be doubled over the year. There may be a problem in grassland areas where bedding straw is not plentiful, and, of course, where straw has to be bought, operating costs will be increased. However, the value of the increased dung production can be set against this.

The forage harvester required is a direct cut machine, since speed of cutting is essential. The higher the throughput and the wider the cut of the machine the better, as frequently short grass may be cut and a larger area will have to be cut to get the necessary tonnage. The trailer should be pulled behind the forage harvester, so that one man can work both. A tractor of at least 35–40 h.p. is required.

When the number of cows is below twenty, the trailer itself may be adapted and left in the yard so that the cows can feed directly from it. Greater numbers should be fed from troughs, which should be outside the yard, eliminating the need for the tractor to go among the cows. The size of the troughs will depend on the number of times the cows are fed each day. It is most common to feed twice daily, although in certain cases it has been done more often. Once-a-day feeding requires larger troughs, and here

there may be a risk of the grass beginning to heat. It also necessitates cutting every day, because if the loads for, say, Sunday, are cut on Saturday they will have heated by the next day and will be less palatable—and that means less milk.

The troughs should be wider at the top than at the bottom—3 feet 6 inches tapering to 2 feet 3 inches. The height on the yard side should be 2 feet and the back should be high enough to prevent the animals nosing the grass over it. A sloped board at the top makes it easier to fill the troughs. If a self-unloading trailer is used, the height of the troughs will be determined by the delivery height of the machine. It is desirable to have vertical stanchions 1 foot 9 inches to 2 feet apart, through which the animal must put its head to feed. This reduces the wastage caused by animals drawing grass amongst their feet. The floor of the trough should be flat so that cleaning out any residue is easy. When animals are fed in a paddock as opposed to a yard, a concrete feeding platform at least 10 feet wide is necessary. The platform and the yard should drain away from the troughs.

Midlothian trial

At Langhill Farm, Roslin, the dairy unit of the Edinburgh School of Agriculture, an experiment has been started to investigate zero grazing under British conditions, to compare its production with that of strip grazing and to determine its costs of operation. The dairy herd, half Ayrshires and half Friesians, has been split into two groups, 38 being run in a semi-loose housing yard where grass is fed and approximately 38 being housed in a traditional byre and strip grazed during the summer. A further experiment is measuring the suitability of this open yard housing under Scottish conditions and comparing it with the traditional method of housing.

The cattle have been zero grazed since May 1956. An outline of some results obtained in the period April 11–October 24, 1957 are given below:

Number of milking cows	38
Number of days	197
Average daily consumption	145 lb fresh grass 26·4 lb dry matter 15·44 lb starch equivalent 2·87 lb digestible crude protein
Total milk production	170,515 lb
Average production per cow	4,488 lb
Average production per cow per day	22·7 lb
Concentrates fed in period to milking cows	94 cwt
Milk production per cow from grass	4,000 lb
Average production per cow per day from grass	20·3 lb
Acreage required to feed cows	32
Production per acre	247 grazing days and 4,752 lb milk

While the production per acre may be considered reasonable, the average daily production is lower than in many cases because the herd is predominantly autumn calving. Higher yields could be achieved, for the potential exists in the quality of the daily grass intake.

The concentrate feeding to the cows during the period April 11 to October 24 was 94 cwt, of which 74 cwt was fed in April, September and October. Some of the concentrates fed were bruised oats, given to ensure the consumption of calcined magnesite by the cows and to quieten nervous cows in the parlour. These concentrates have been given a milk-producing value which makes the milk production from the grass lower.

The actual grass feeding was from April 4 to November 11, which is considerably longer than usual in the east of Scotland.

Cutting and carting at 11s. per ton

Cutting was carried out by the arable staff and feeding mainly by the dairy staff. Two-wheeled trailers with a capacity of 30 cwt of grass were used, which necessitated two loads per day. The fields cut were approximately one mile from the steading, and the daily time for cutting and carting was 2½ hours. The actual cutting time was only 30–35 minutes. A direct-throw forage harvester was used, and cut over 1,200 tons of grass in the season. The machine charge was 1*s.* 10*d.* per ton of grass. The total cost of cutting and carting under our system was approximately 11*s.* per ton.

Refrigeration and Marketing of Watercress

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During the past three seasons the Department of Scientific and Industrial Research has, with the co-operation of the Ministry of Agriculture, carried out experiments on the application of refrigeration on watercress for marketing. The results suggest that refrigeration could be used with advantage to grower, distributor and consumer.

THE highly perishable nature of watercress makes quick transit between the beds and the consumer imperative. The crop quickly wilts and loses its colour during the early stages of marketing. Subsequently, the leaves may rot, become slimy and smell unpleasant. During the winter, well-grown cress arrives on the market in satisfactory condition, but when the weather becomes warmer, deterioration is more rapid. Moreover since the war, loadings to market have normally been heavier at the end than at the beginning of the week, and this has resulted in an uneven and uneconomic deployment of labour. Refrigeration may solve both of these problems.

A mobile refrigerated store was taken to the packing shed of a Dorset grower, and a series of experiments, planned to lay a foundation of know-

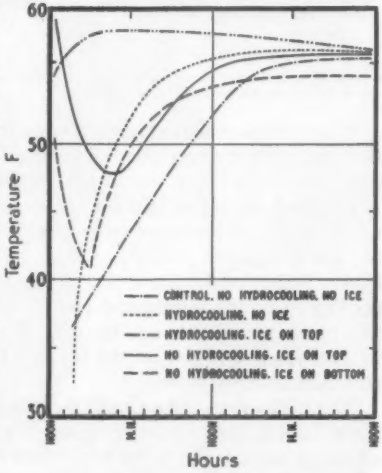
ledge on which to base commercial practice, was carried out. We wanted information on the following points:

1. The best way to cool watercress and keep it cool and moist during transport.
2. The best procedure and maximum period for storage under refrigeration if watercress is to reach the distant consumer in satisfactory condition.
3. The development of a new and economical package that will improve the marketing of precooled watercress.

Effective cooling

It is essential to cool watercress quickly, with the minimum loss of moisture. Circulating cold air results in excessive loss of moisture and wilting. We therefore decided to try cooling by immersion in ice-cold water (hydrocooling) and carriage packed with crushed ice.

Small-scale tests were made with a small and simple hydrocooler consisting of two tanks, one containing blocks of ice and water and the other for submersion of the watercress. The two tanks were connected by a pipeline and had a circulating pump and filter. These tests showed that water must pass through the chip if cooling is to be quick and effective. Thus when single baskets already packed were merely submerged in water at a temperature of 33–34°F, the watercress at the centre took 18 minutes to fall to 34°F. When the basket (without lid) was placed under a rose, so that a gentle spray of water fell on it and drained through, the temperature fell from 57° to 36°F in 3½ minutes.



Change of temperature of watercress in veneer baskets under hydrocooling and icing treatments.

A further series of trials was then carried out using watercress in units of two dozen bunches packed upright in a veneer basket, the grower's normal method of packing. Comparison was made between the behaviour of samples hydrocooled to 34–35°F and control samples which had received no cooling. The hydrocooled samples were subsequently treated in two ways. Either they were allowed to warm up naturally, or they were packed with crushed ice at the rate of 2 lb per chip basket, placed in a layer at the bottom of the basket or laid on top of the cress. Comparison was also made with cress that was not hydrocooled at all but merely packed in the basket with ice. All the baskets were then covered by the usual veneer lids, which were tied down with string.

The temperature history of baskets treated in this way and stood singly in a room at ordinary temperatures is shown in the graph. The temperatures were measured by thermocouple junctions in the bundles of stalks. The advantage of hydrocooling is brought out very clearly. The rapid drop in temperature which it gave was followed by slow rise. This is contrasted

with the much slower cooling achieved by contact with crushed ice. Subsequently, detailed observations showed that the rate of deterioration of the watercress could to some extent be related to the degree of cooling secured. For convenience this may be termed the "effective cooling", and measured by the product of the number of degrees the temperature of the cress was below the temperature of the control samples and the number of hours between the beginning and end of the observations (that is, a period of twenty-four hours). The following table gives the results of such a comparison.

Treatment	"Effective cooling" No. degree-hours below temperature of control sample	Percentage deterioration* One day after packing		Two days after packing	
		Yellowing	Wilting	Yellowing	Wilting
Control	Nil	10	8	36	36
No hydrocooling; ice on top	138	7	7	0	28
Hydrocooled; no ice	163	2	2	19	31
No hydrocooling; ice on bottom	206	8	7	25	33
Hydrocooled; ice on top	281	8	3	0	14

* These figures express the increase in percentage of score points subtracted from the original 100 per cent (free from defect) as yellowing and wilting progress.

It is perhaps worth noting that had the cress been kept at 34°F throughout the period of twenty-four hours instead of being allowed to warm up, the total *effective* cooling would have been approximately 576 degree-hours.

The best treatment proved to be hydrocooling followed by "top icing", which gave the highest degree of effective cooling. Later it was found that for convenience in packing, 3 lb of ice could be placed in the bottom of the basket before packing and there would still be a little under 2 lb after hydrocooling to retard subsequent rise of temperature. This was just as effective, and moreover it overcame the difficulty presented by deposition of a residue of salts from solution on the leaves of the cress when the water left on the surface had evaporated.

The trials were subsequently extended with success to the treatment of small consignments passing through normal market channels. Checks were made on single isolated baskets; when baskets were built into a stack the rise of temperature was much slower and the effective cooling therefore greater.

There is very little room for doubt that refrigeration would improve the condition of watercress on the market during the warmer periods of the year. Moreover, at the retail stage of distribution the cooled and iced cress sent off on the day of cutting would deteriorate less rapidly than untreated cress. The onset of wilting and yellowing of the leaves would be delayed.

Storage and packing

Storage trials at a temperature of 33°F were carried out with both French and American varieties of watercress. Because cress must remain in good condition after storage and during the normal period of marketing, periods of storage from one to fourteen days were tried out. Cress was stored ready packed for market and also loose as it came from the beds for subsequent packing. It was stored both with and without a layer of ice on top of the package, the melting ice serving to provide a constant source of moisture.

Photos: *W. Hugh Smith*

Refrigeration and Marketing of Watercress

Small experimental hydrocooler in use. Water must pass through the chip if cooling is to be quick and effective.

Placing thermocouple junctions for measuring temperature in baskets of watercress in mobile storage chamber. Crushed ice can be seen strewn over the baskets.

Refrigeration and Marketing of Watercress (Article on pp. 132–5)

Mobile cooling and storage chamber used for experiments.

Photos: *W. Hugh Smith*

Experimental carton pack for precooled watercress. The carton is lined with 150 polythene film. Refrigeration for transit is provided by crushed ice in a polythene bag closed by an elastic band.

Silage for Milk and Meat (Article on pp. 107–11)

Silage harvest on the Seale-Hayne Agricultural College Farm. Silage must, says Professor Ian Moore, be of high feeding value and economical in comparison with alternative foodstuffs.

Photos: *H. Ian Moore*

The proof of the silage is in the eating. In the self-feeding yards at Seale-Hayne cows have never been fitter.

Photo: *Edinburgh and East of Scot. Coll. of Agric.*

Zero Grazing of Dairy Cattle (Article on pp. 129–32)

Taking grass to stock. Efficient machinery—a forage harvester and, if possible, a self-unloading trailer—are essential for this system.

Packing the baskets after storage proved better than storing baskets already packed. Ice on top of the packages was also an advantage, as it kept the cress moist and turgid. Watercress was stored with and without prior hydrocooling. Hydrocooling was noticeably favourable to subsequent behaviour in storage.

It seems from these experiments that storage for long periods is inadvisable, and that for first-class presentation on the fresh vegetable market 3–4 days is the maximum permissible period. Moreover it will probably be advisable to transport stored cress to market in contact with crushed ice. The storage of cress cut on Monday and Tuesday for Friday's market is quite feasible.

Although satisfactory results were achieved by hydrocooling watercress and then packing it with a layer of crushed ice, using the conventional chip basket and veneer lid, the need was felt for a pack which might permit watercress to make a longer journey, arriving fresh forty-eight hours instead of twenty-four hours after packing. To do this, loss of moisture must be strictly limited and temperature kept below the prevailing air temperature for a fairly long period.

Experiments showed that this end could be secured if cress was hydrocooled to 35°F, drained in a cold room, and packed immediately into a corrugated cardboard carton lined with polythene film, with 2–3 lb of crushed water ice in one or more sealed polythene bags.

The objections to a pack of this type are twofold: firstly, there is the increased cost of the package, secondly the difficulty and added cost of packing. In the light of experience the first objection may not prove valid, particularly if a standard package such as a robust cucumber tray accommodating four dozen bunches can be used. The validity of the second objection can be tested only by commercial experience. It now remains for an enterprising grower to put up a pack of this sort and determine whether the improved market condition of his cress warrants the change-over from the veneer basket.

Refrigeration a practical proposition

The results of the experiments described here encourage the belief that the prudent use of refrigeration of watercress could lead to arrival of fresher produce on the market and less wastage. The measures that could be adopted are hydrocooling at the beds and the use of crushed ice in transport by rail or road (preferably in an insulated container). Short-term storage of 3–4 days' duration would enable the labour available at the beds and packing-house to work more evenly through the week and yet meet the heavier end-of-week loadings. The cost of installing and operating the necessary equipment should not be out of proportion to the benefit likely to accrue or more than the crop can bear.

The work described in this paper was carried out, as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research. Field work was largely carried out by Miss R. Jamison, D. J. Chappell, T. W. J. Wright of the Ditton Laboratory, R. T. Deakin and A. Skelton of the Marketing Division of the Ministry of Agriculture.

Reducing Costs through Work Study

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Work study should be directed immediately to those ends which are likely to ensure the greatest return.

Greater productivity implies production at lower cost and higher profits. In farming, especially, greater labour productivity is important because of the particular need to keep down labour costs and to maintain production with fewer workers.

Despite extensive mechanization over recent years, farm wages continue to be the most important outlay, although in many ways it is more useful to couple labour and machinery costs, and to consider the importance of total expenditure on both manual and mechanical power. This accounts for some 45–50 per cent of total costs on the average mixed farm and up to, say, 60 per cent on cropping and feeding farms. Yet we must expect labour to become even more expensive. Between 1949 and 1955 some 124,000 workers left agriculture, whilst more recently 3 per cent of the labour force has been lost each year. Perhaps it is as much a result of mechanization as a cause of it, but we must expect the trend to continue until stability is reached, with fewer workers but higher wages. This is economic progress and not to be discouraged. It implies a higher standard of living and a higher status for agricultural workers, skilled men competent to operate and maintain expensive machines for the farmer. It also implies a need for radical changes in farm organization, methods, and outlook.

When labour was cheap and land relatively scarce, output per acre was considered a good indication of efficiency. Today output per acre is important in so far as it sets an upper limit on production, but much more emphasis must now be placed on a high output per man, and on output in relation to expenditure on labour and machinery.

Profit, of course, is the only comprehensive measure of efficiency, and an economic analysis of a farm's accounts is the most accurate way of finding out the cause of low profits. For example, they may be due to low yields and to some technical fault, or to not producing the right things at the right time. Only if yields and the farm programme are satisfactory can we blame excessive expenditure for low profits. Yet if output is satisfactory the farmer should look at his expenditure as the likely cause of low profits, and at output in relation to expenditure on labour and machinery as an indication of the efficiency with which these two factors are being used. Only then can he be certain that there is a labour problem, and only then will it always be worth looking further into the details of labour use.

Saving labour as a means to an end

It is not reasonable, having shown that there is a labour problem, to apply work study indiscriminately, or to make changes without regard to a correct order of priority. In particular, it is not normally sufficient simply to save

labour. To be effective, any economy in labour must lead to a reduction in labour costs, or the labour saved must be productively re-employed. For example, work study can usefully be applied to obtain surplus labour for expansion. Alternatively, it should be applied to the routine work on livestock and to crop cultivations which occur at exceptionally busy times of the year, both of which contribute to labour bottle-necks. Only at such times will a more efficient use of labour normally be effective either in reducing labour costs or in enabling the same staff to produce more.

Yet a critical consideration of labour use may suggest that a better machine or a new building would be justified by saving labour, whilst sometimes it is not sufficient for the value of the labour saved to outweigh the annual cost of a new building or a new machine. With limited capital available, investment should be directed to ensuring the greatest return, and on many farms there is a need for further investment in directly productive livestock and in more fertilizers, rather than in labour-saving buildings and equipment. Obviously, if changes involving capital expenditure are to be considered, work study should be subordinated to the wider considerations raised by the analysis of a farm's accounts.

Used in this way, there is obvious scope for work study on the farm. Not only may it be employed to improve work methods and routines: it may also suggest improvements to buildings and equipment and help to choose new buildings which will use labour efficiently. In particular, it can be used on the drawing board before capital has been committed to any particular design; in this connection an indiarubber is undoubtedly cheaper and a great deal more effective than a bulldozer.

Labour and livestock

On the average farm, if milking and egg-handling are excluded, 80–90 per cent of the great amount of time spent on stock is occupied with handling and distributing feed and litter. This is not work requiring any high degree of skill; if it can be reduced, the stockman has more time rather than less in which to practise skilled stockmanship.

Like so many other jobs on the farm, feeding and littering are concerned with the movement of materials, and effective handling should be a primary objective. Its importance can be illustrated by showing differences in the times taken to distribute food to yarded bullocks:

Farm	Feeding times (*man-hours per bullock per winter yarded period*)	Distance walked (*yards per bullock per day*)	Weight of food handled (*lb per bullock per day*)
	Farms with high feeding times		
1	19	166	52
2	16	98	67
3	14	100	43
	Farms with low feeding times		
4	1	12	16
5	2	11	6
6	2	16	17

The distances walked and the weights of food handled are considered to

indicate the handling involved in feeding on each farm. It is apparent that high labour requirements are associated with heavy handling and long distances, and that very high labour efficiency can be achieved by reducing the handling of materials to a minimum.

That there is sometimes great scope for saving labour can best be illustrated by reference to the work on livestock and to the very wide differences in labour use on different farms.

In particular farm samples it was found that anything from 4 to 28 man-hours a year were used to fatten a bacon pig, that from 7 to 75 man-hours were needed to tend a breeding sow, and that from 5 to 27 man-hours were taken to winter a yarded bullock. Whilst labour is employed very effectively on some farms, on many others a critical examination of layouts, equipment and methods could result in much better use of labour. Nor should work study be thought of as a means of saving minutes and seconds, but rather as a way of saving hundreds and even thousands of hours a year.

Black-leg

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The disease known as black-leg or black-quarter strikes suddenly and runs a swift, fatal course among ruminants. Vaccination is a cheap and effective insurance against it.

VARIOUSLY called quarter-ill or black-quarter, the disease black-leg has been known for at least a century. It chiefly affects ruminants, is of fairly world-wide distribution, and is characterized by profound and rapid changes in some of the muscles, almost invariably ending in death. The time-honoured methods of controlling it have succeeded only partially, so it is appropriate to revise our knowledge and to stress how losses can be reduced. Until late in the eighteenth century the disease was confused with anthrax. Approximately a century later its cause was determined, and a practical method of vaccination followed.

Cattle are most commonly affected between six months and two years of age, although it is not uncommon for younger calves and beasts of up to four years to be attacked. Sheep are involved to a lesser extent, but it is rare for horses and swine to be affected. Man appears to be immune.

Black-leg is common in most cattle-raising districts, but is generally very local, occurring on certain fields while the adjacent ones are free. Most cases occur during the warmer part of the year, although they have been known in the depth of winter, even among housed cattle.

Bacterium and muscular damage

The causal organism, *Clostridium chauveoi*, belongs to a genus, *Clostridia*, which is composed of organisms that will grow only in the absence of oxygen and includes many that produce disease in both animals and man. *Cl. chauveoi* produces spores which allow it to survive in a latent state for long periods under adverse conditions. Occasionally outbreaks resembling black-leg are encountered which are caused by related organisms, *Cl. septique* or *Cl. oedematiens*. Black-quarter in lambs after docking or castration may be due to *Cl. oedematiens*. On culture and in muscle it produces a toxin and gas in abundance. *Cl. chauveoi* is a saprophyte, living and surviving in the soil, and has also adapted itself to a harmless existence in the alimentary tract of animals and man; thus once a field or locality is infested, the organism can survive for many years. Most such localities are permanent pastures, although cases can occur on any type of land or herbage.

The disease generally affects animals in good or fat condition. The organism enters the bowel on contaminated herbage or food without producing the disease, which is set up by a method imperfectly understood. The organism enters the body and finally settles in muscle tissue, the predilection site, producing the changes to be described—probably because the chemical and physical conditions are most suitable for the growth of the organism. The injection of the organism direct into muscular tissue experimentally does not always reproduce the disease. The defences of the body rapidly annihilate the invader. If, at the site of injection, the muscle tissue is damaged, then the typical disease processes take place. This can be brought about either chemically or physically by the introduction of harmful substances called kataphylactic agents, such as lactic acid or powdered pumice, which damage the tissue to such an extent that the invading organism can multiply unmolested by the defences of the body.

With this knowledge it is possible to have a better understanding of the actual cause of the disease in natural outbreaks. Practically any part of the skeletal muscular system can be affected. The commonest sites are the muscles of the fore and hind limbs, chiefly the buttocks and shoulder region. The neck and throat muscles, tongue, muscles of the back and abdominal wall can also be involved, while internally the muscular walls of the oesophagus, gut and diaphragm are only rarely affected. Animals are susceptible at from six months to two years and, as this period corresponds with the times when tooth changing is most active, it is thought that infection gains entrance to the body via the empty tooth socket. This may explain why the throat and neck are involved. Cases can arise after castration, docking, calving or obscure injury, but in the majority of instances it is not possible to find the exciting cause.

Swift onset of symptoms

The anatomical changes or lesions are mainly confined to muscle tissue. When incised, it appears dark red to black, rather dry in the centre, and the muscle fibres are disrupted by local gas formation to give almost a lattice-appearance; the sound of cutting is reminiscent of incising inflated lung

tissue. The surrounding area also contains a gas and a reddish-yellow liquid. The adjacent lymphatic glands, which normally collect lymph from the affected site, are invariably grossly swollen and blood-stained. A blood-stained exudate may also be found in the thoracic and abdominal cavities, as well as on the pericardial sac. The affected tissues smell strongly of butyric acid or rancid butter, which is one of the breakdown products of the organism's metabolism. They never occur below the knee or hock, as no muscle tissue of note exists there. The muscle lesion, if superficial, produces necrosis of the skin, which appears very dark in colour.

The symptoms seen depend upon how closely the beast is observed during the course of the illness—indeed if the stock are only looked over once a day, then it is possible for the beast to be found dead before any symptoms have been noticed. Generally, however, the affected animal gets away from the herd and appears dull, stops eating and ruminating, and may show lameness. Only a close examination will give a clue to the cause of the illness, which will reveal over the affected muscles a swelling which is warm, very painful and containing gas. When tapped, the skin over this area gives a drum-like sound, or on being pressed firmly with the hand gives a gurgling sound of moving gas through the interstices of the tissues. The size of the swelling rapidly increases, the skin becoming tighter and more drum-like and less sensitive, until finally, owing to the complete tissue destruction, it is completely insensitive—so that it can even be incised without pain. At first the temperature rises quickly, but towards the later stages falls; when death approaches it is often subnormal. Respirations are grunting in type; the heart beat is accelerated but gets very weak shortly before death.

Occasionally several such sites appear and coalesce as they enlarge to form one large affected area. Rarely, symptoms of colic or bloat are observed, due to involvement of a deeply situated muscle which does not give rise to the usual external swellings. Such sites are the oesophagus, abdominal wall and diaphragm. Finally the beast dies from a toxaemia.

The course of the disease is usually rapid. The majority of cases end fatally in from one to three days. Occasionally death can take place in about twelve hours, and some cases have been known to linger for several days.

The diagnosis from symptoms and post-mortem results is generally straightforward. The infective organism can be found in large numbers, not only in the primary muscle lesion, but also in the serous cavities—even in the blood-stream in some cases. Material from these sites, suitably prepared and examined with the microscope, reveals the rod-shaped bacteria, many showing spores attached to them.

These facts merely suggest the type of organism causing the disease and do not prove its complete identity. This can be done only by a detailed study of its behaviour when grown in culture. It is advisable to know the identity of the organism so that the appropriate vaccine may be used, since organisms other than *Cl. chauveoi* may be the cause.

Inoculation and vaccination

Two methods are available. Anti-serum in fairly large doses is effective only if used *very early* in the course of the disease, but it can be used to protect the remainder of the herd when some animals are found to be in-

fected. In these animals the disease will probably have advanced too far to yield to the anti-serum.

The second form of treatment, which has been increasingly popular in the last few years, involves the use of antibiotics by injection. If the injections are given *early* and in large doses, their chances of success are reasonable. Antibiotics in the food have no effect, either as a cure or prevention.

When the earlier workers had identified the cause, methods were at once tried out to produce vaccines. The earliest were very crude, and of doubtful efficacy. They were tapes, soaked in an irritant such as turpentine, or even in a culture of the organism, and then threaded through the flesh of the brisket or tail. Their action was to depress the well-being of the animal and hence reduce its chances of becoming affected, or to inoculate it with the organism (either directly from the tape or from soil-contamination of a consistently open wound) in order that antibodies might be produced.

During the last century several types of vaccine have been developed, many with marked success, and today safe and effective vaccines are readily available. The dose is small, which makes for easy administration, and they are very potent in producing a high level of antibodies in the beast. In addition, they are safe, in that no fatalities occur after inoculation. A second injection 2–4 weeks after the first gives an even stronger immunity. Antibodies are produced in significant amounts 2–3 weeks after dosing—in other words, treated animals can be put at risk at this period, although the full protective effect is not realized until later. Animals are best inoculated in the spring or when they become age-susceptible; alternatively just before the black-leg season. One dose confers a long immunity, although in badly-affected areas a boosting dose can be given annually.

If protection is required *immediately*, anti-serum can be given, followed soon after by vaccination.

It may be appropriate here to summarize briefly the difference between an anti-serum and a vaccine, as these terms are confused even today. Inoculation of a vaccine into a beast causes the defensive mechanism of the body to produce protective antibodies, which circulate in the blood. Antibody production does not generally reach effective proportions until at least ten days after vaccination, but the resistance remains for a long period—often for the remainder of an animal's life. Hence, the animal is, for all practical purposes, permanently immune to the disease. The animal is then said to be "actively" immune.

An anti-serum is prepared from the blood of an animal that already is highly immune. Injection of the anti-serum into an animal gives protection which is immediate, but lasts for only 2–3 weeks. Such immunity is said to be "passive".

Another preventive method, if conditions allow, is to keep susceptible stock away from fields where cases are likely to occur. Animals which have died of the disease should be disposed of in such a way as not to contaminate the ground.

Vaccination is an effective and inexpensive insurance against black-leg. By making effective use of existing scientific knowledge, losses could be reduced to negligible proportions.

Sugar Beet on the Small Farm

T. KEMPINSKI, M.A.
University of Manchester

Sugar beet can be profitable on a small farm. Prices are fixed by contract, and beet tops are valuable for stockfeed.

THE acreage of sugar beet in England has remained fairly constant in the last few years, but there are signs that many small growers have been reducing their acreage or abandoning the crop altogether. This is perhaps natural if the size of the profit margin on sugar beet is considered, for results published by agricultural economists often show poor margins on the small acreages. For example, in a survey conducted in north-west England in 1956,[6] the growers with 10 acres or less of sugar beet had a cash deficit of £3 5*s*. per acre, compared with an average cash surplus of £19 8*s*. per acre realized by the larger growers. (These figures do not take into account the value of tops.) The low profits received by the small growers appear to result from their relatively high production costs, often coupled with low yields.[1, 2, 6]

There are several reasons why the smaller farms have higher production costs. First, these farms are at a comparative disadvantage in most branches of production, because their size may not warrant buying the more expensive types of time- and labour-saving equipment, such as wider or more highly mechanized implements. Then the proportion of time spent on preparing for the job and travelling to the field is bound to be greater when a relatively small acreage is involved, thus increasing the cost of the operations per acre.

In sugar beet growing, other disadvantages of small-scale production can be seen as the progress of operations is followed throughout the season. On many of the small farms dairying is the main enterprise; hence the quantity of farmyard manure per acre of land is relatively high, and this adds to the cost of production without allowing a corresponding reduction in the cost of artificials. In spring and early summer, small farmers are unlikely to be able to spare the labour—estimated in one survey at 57 man-hours per acre—necessary for singling and hand-weeding.[1] This may mean a sizeable casual labour bill. At lifting time only a few small growers use mechanical harvesters, which—according to some estimates—can save up to £4 per acre on the cost of lifting and topping.[4, 5] A similar amount is probably saved—assuming a distance of about 10 miles—by producers who carry beet to the factory in their own lorries, compared with the charges which the smaller grower has to pay the transport contractor.

A rather extreme example of the cumulative effect of these various drawbacks on the total cost of production is seen in the latest Manchester report, where the average gross cost per acre of sugar beet grown in lots of 10 acres and under is shown to be £8 greater than the cost of growing more than 10 acres.

While all this points to the conclusion that sugar beet can be grown more cheaply and more profitably on a large than on a small scale, it is not a sufficient argument against growing the crop on small farms. In the first

place, some of the disadvantages—such as the low degree of mechanization, the insufficient reserve of manpower and the relative slowness of operations—are not peculiar to sugar beet production, but are part and parcel of the "small farm problem",[2] which is beyond the scope of the present article. For our purpose we have to assume that a farmer cannot increase his total acreage, and that he must decide whether sugar beet is worth growing within his established farming system.

Advantages for the small farmer

Considered in this way, the arguments against sugar beet growing appear much less formidable. True, the labour requirements are high; but since the harvest can be spread over several months, it may often be possible to gather the beet with little or no additional expense on casual labour. If sugar beet replaces potatoes or some other root crop, there is probably no increase in the tractor fuel and maintenance bill; there is not much difference between the number of tractor-hours worked on these crops.

Similarly, although the charge for farmyard manure looms large in many small growers' costs, the spreading of dung is a necessary part of the farming routine and cannot be dispensed with, irrespective of the crops grown.

As regards returns from the crop, the beet tops may reasonably be considered much more valuable to the many small growers whose main source of income is dairying, than to the large arable farmers. This can lead to striking results in a season favourable to leaf growth. For example, the value as feed of tops from a crop grown in the conditions of the 1956 season and yielding 12 tons of roots may be taken as £12 per acre, compared with the manurial value of only £4 per acre for tops ploughed in. Thus, when the value of tops is credited according to their utilization, the relatively greater return achieved by the small dairy farmer may well turn a deficit into a profit on the crop.

Another item may be put to the credit of growers with dairy herds and therefore probably affects more small growers than large. This is the special concession by which growers can purchase beet pulp from factories at the trade price, thus saving about 3*s*. a cwt; since this special price applies to 1½ cwt of dried pulp for each ton of beet, the saving would amount to £2 14*s*. per acre on a 12 ton crop.

Criterion of the beet crop

In fact the question whether sugar beet is worth growing on a small farm cannot be answered by comparing financial results achieved by large and small producers or by looking at complete cost accounts of sugar beet side by side with other crops. A more valid criterion is whether the beet will add to the net farm income, compared with other crops which might be grown in its place. Fixed costs, that is to say, those expenses which have to be borne irrespective of the particular crop grown, can be ignored for this purpose. The touchstone will be the surplus of returns over variable costs—those expenses which are specifically incurred by the crop selected, such as fertilizer, seed, tractor fuel and casual labour.

Since financial returns from farm crops vary from year to year and district

to district, the following figures are intended merely as a guide, to be used by each farmer according to circumstances.

Financial result of crop production (£ per acre)

	Sugar beet	Potatoes	Barley (combined by contract)	Kale (grazed)	Grass ley
Contract or casual labour	20	15	6	1	—
Tractor fuel	3	3	1	1	0·4
Seed	1	17	3	2	3·6
Fertilizers	13	13	2	5	6·0
Transport	7	—	—	—	—
Total variable costs	44	48	12	9	10·0
Return (or feed value)	85	100	40	61	45·0
Surplus	41	52	28	52	35·0

The table shows that sugar beet leaves a larger surplus than a ley or a cereal crop but a smaller surplus than kale or potatoes; but it is based on a number of assumptions which may well be outdated soon by the march of agricultural progress.

Mechanization and better techniques

The cost of casual labour for sugar beet is high because many small growers hire gangs for "knocking and topping", as well as for the spring hoeing. Yet it need not be; by purchasing two relatively cheap implements—a topper and a lifter—even a small grower can save, say, £8 per acre on casual labour, while only some 12*s*. need be spent on fuel for the additional 5 or 6 hours of tractor work. On this basis a set of machines costing £100 would save the farmer a net sum (assuming 20 per cent depreciation in the first year) of £2 8*s*. per acre on a 4 acre crop.

Even on the smallest acreages something can be saved if the beet is harvested by a contractor. But the best solution of the harvesting problem would seem to be for a number of small growers to purchase and operate a complete harvester co-operatively. Given a sufficiently large acreage over which the cost of depreciation and maintenance can be spread, these machines can operate very economically; their co-operative use would give even the smallest grower some of the advantages enjoyed by the large producers.

There is less evidence from farm surveys as to the saving in spring labour that can be achieved by the use of rubbed seed, spacing drills, weed spraying, and down-the-row spinners. But these methods may be worth considering, especially if the implements can be bought in partnership and the fears of excessive reduction in yield are dispelled.

On the "return" side, improvements can be made through greater care in cultivation and manuring. Many small growers do get high yields; and the fact that in the Cambridge survey,[3] average yield was practically identical on small and large farms does seem to point to the possibility of a general improvement in the small growers' yield.

Through increased mechanization and better techniques, it may be possible for a small farmer to add as much to his net income by growing sugar beet as by growing a similar acreage of potatoes. Even if such good results are not secured, there is much to be said for including sugar beet in the rotation.

Prices are fixed by contract and therefore much more predictable than potato prices, which have been rather variable in recent years; beet tops and pulp are welcome and inexpensive additions to the stockfeed; and growing sugar beet can extend the interval between potato crops, thus reducing the risk of damage by potato root eelworm.

A few acres may be won for sugar beet

In deciding whether to grow sugar beet or a fodder crop such as kale, a farmer cannot be ruled purely by a comparison of the probable financial results. The value of a feed crop cannot be predicted accurately when it is to be fed on the farm; and the decision will depend mainly on the food requirements of the livestock. It is, however, worth considering that with improved management of the land and of grazing, the existing grass acreage may yield the equivalent of an extra crop of kale, so that the field intended for growing kale may provide a cash crop of sugar beet instead.

Finally, it should be noticed that much of the land formerly occupied by sugar beet is now probably under grass. Unless such a change is accompanied by an intensity of grassland management far beyond present-day standards, it seems likely that small farmers would be well advised to retain their existing sugar beet acreage, while trying to increase the output of their grassland.

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★ NEXT MONTH ★

In view of the venue of this year's Royal Show at Bristol, interest will be focused on the pattern of farming in Gloucestershire, Somerset and North Wiltshire.

Horticulture in the Canaries

R. C. M. WRIGHT, N.D.H.

Tomatoes are the second most important crop in the Canaries, and most of them are grown on holdings of about two acres.

MENTION of the Canary Islands immediately calls to mind tomatoes, for during the winter months this is our principal source of supply. Consequently when I visited these Spanish Islands last year I was particularly interested in the method of tomato production practised there. These mountainous little islands, about 100 miles off the West African coast, are of volcanic origin. The climate in the lower regions is mild and equable. Thus at Santa Cruz, the capital of Teneriffe, the mean annual temperature is about 71°F, and the daily variation rarely exceeds six degrees.

Although the rainfall varies in different parts of the islands, it is usually inadequate for crop production. The saying "to own water in the Canaries is to be rich" is significant enough. Naturally, therefore, every drop is carefully conserved and, by an ingenious system of channels (in all the islands), water is brought from the mountainous districts to the lowlands for storage in circular reservoirs to meet the needs of the crops.

The flora of the Canaries is characteristic of both warm and cold climates. Thus the date palm and the orange tree flourish in the lowlands of Teneriffe, while high up on the mountain slopes pines and heaths can be seen. A wide range of decorative plants, especially those from warm climates, are easily cultivated in the Canaries. Many kinds of ornamental palms attract attention, and brilliant flowering plants such as bougainvillea and poinsettia are common. Of particular interest is the Dragon tree (*Dracaena draco*), and two specimens on Teneriffe are claimed to be probably 2,000 years old. The most famous specimen which grew in Teneriffe was blown down in a gale in 1868. It is reputed to have been 6,000 years old, and was 70 feet high, with a stem 45 feet in circumference. The original natives of Teneriffe held this tree in great reverence, and it was associated with their religious ceremonies.

Cultivated fruits grown in the Canaries include oranges, figs, walnuts, almonds, custard apples, avocado pears and mangoes. Grapes used to be grown extensively, but, because of serious trouble from powdery mildew, only a comparatively small quantity is produced now. Sugar cane was another important crop at one time, but largely due to severe competition from the West Indies its production has been greatly reduced. The production of cochineal dye was also very important in the last century, but now because of the discovery of aniline dyes, it has declined almost to insignificance.

Bananas rank as the most valuable commercial crop, of course, and are exported all the year round. The area devoted to this crop is about 10,000 hectares. Tomatoes are next in order of economic importance, about 8,000 hectares being devoted to them. They are produced from October to June, and the bulk of the crop is exported to the United Kingdom. Early potatoes are exported from January to April. The area of potatoes grown annually is about 20,000 hectares. Onions are another crop which is grown fairly extensively.

Tomato-grading on small holdings

Tomatoes are cultivated chiefly in the lower zones of the islands of Grand Canary, Teneriffe and Gomera and in smaller areas in the other islands. The rainfall here is normally about eight inches each year, most of which comes during the winter months when the tomatoes are being grown. The majority of holdings in the Canaries are small, and the area devoted to tomatoes by individual growers is rarely more than one hectare. Tomato seed is obtained almost entirely from England, and the two principal varieties grown are Stoner's Exhibition and Devon Surprise, which is very popular in Jersey.

The plants are raised in the open, great care being taken with the seedbed. A level sheltered site is prepared on light sandy soil having a high content of organic matter and free from disease. If there is any doubt about fertility, an appreciable quantity of well-rotted manure is worked into the soil to a depth of 8 inches. Finally the bed is finished off by covering the soil surface with a layer 2–4 inches thick of fine manure (*mantillo fino*), either pure or mixed with good soil in the proportion of two parts manure to one of soil.

Normally the seedbeds are made 4–4½ feet wide. In the damper districts the beds are raised above the surrounding soil, but in dry country they may be sunk slightly. The seed is sown broadcast over the beds at the rate of 4 grams of seed per square metre bed. After sowing, the seed is covered with a light coating of fine calcinated sand or ashes, and the beds are then watered through a fine rose. To protect the seeds from sudden changes in temperature, the beds are sometimes covered with sacking, straw or dry foliage.

The seedbeds are watered every day with a fine rose so as to keep the soil nicely moist. For this purpose the surface covering is removed, but it may be replaced again temporarily to prevent damage from hot sunshine or chilling at night. Weeds must be kept down from the early stages by careful hoeing.

As a general protection against disease the seedlings are usually sprayed with Bordeaux mixture. Against lizards and caterpillars, the foliage is sprayed with lead arsenate or DDT. Any deficiency of an important plant nutrient is said to cause characteristic symptoms in the seedlings: thus lack of phosphate induces dark stains and a bluish colour of the leaves, whereas a shortage of potash gives rise to white patches on the leaves and some yellowing.

Planting out to packing

The transplanting of tomatoes from the seedbed is done from July until December, and small lots of seeds are sown in succession about 30–40 days before the plants are required. The soil is prepared some weeks in advance of transplanting, and fertilizers at the rate of 6,000 kilos per hectare (over 2 tons per acre) are applied. Only healthy seedlings are transplanted, and each should have three or four leaves of a good green colour. Any "thready" specimens with poor roots or those with yellowish foliage or hardened woody stems are rejected.

Shortly after planting, stakes or canes are put in along the rows, to which the plants are kept tied with raffia or strips of banana leaf. The plants grow and produce fruit for about six months, and during this period they are

supplied with water at the rate of 10,000 cubic metres per hectare. This works out at the enormous quantity of about 40 inches to the acre.

Virus diseases are said to be widespread in the islands and cause a considerable reduction in yield. One of the worst fungus diseases is Alternaria blight (*Alternaria solani*), which causes brown and black markings on the leaves and stems. The disease also attacks the fruit, causing it to rot or fall prematurely. To combat fungus diseases, sulphur is dusted on the plants at the rate of 600–800 kilos per hectare. Salts of zinc and copper are also used as sprays.

The principal pests are red spider and several caterpillars, including surface caterpillars such as the larvae of *Agrotis segetum* and *Heliothis obsoleta*. Chlorocide is favoured for the control of the red spider, while DDT or lindane is used to destroy caterpillars.

Picking from the lower trusses of the earliest planted tomatoes usually starts in October and continues throughout the winter until May or June. In the cooler months of the year the fruit is harvested just when it is beginning to colour, but when the weather is warmer it is picked quite green to allow ripening during transit. Thus seven or eight days must be allowed for transport of the fruit to England.

After the fruit has been removed from the plants it is sent to one of the grading and packing stations of exporters. There it is packed in the familiar boat-shaped containers called bandejas. These are first lined with paper and then filled with tomatoes individually wrapped in sulphite paper and wood shavings in alternate layers. The weight of each package is 6 kilos net.

Harvesting and packing is done mainly by women. They are very poorly paid, their earnings being only about two or three shillings a day. Great care is taken in the selection of the tomatoes and considerable quantities have to be rejected because of damage due to caterpillars, fungi, skin scorching or wind.

The average yield per hectare of graded fruit is about 20,000 kilos, which is roughly equivalent to 8 tons per acre. Up to 75 per cent of the crop is exported to the United Kingdom: this amounted to 98,791 tons in the period 1st October 1956 to 30th June 1957.

For assistance in collecting the information in this article the author wishes to express his appreciation to Dr. Antonio Lavin, Agricultural Attaché Spanish Embassy, and to Sr. Don Jorge Menendez, Chief of the Government Agricultural Centre of Santa Cruz.

Crop Protection Products: Approved List, 1958

The new list guiding all growers to the chemical products required for controlling crop diseases, pests and weeds is available free from the Ministry of Agriculture (Publications), Soho Square, London, W.1.

New groups of chemicals now included are aldrin-organo-mercury seed dressings, dieldrin-thiram dry seed dressing, 2,2,5-T, 2,4-D ester sprays, and TCA sprays.

Farming Cameo: Series 2

3. East Berkshire

W. A. VINCENT
District Advisory Officer

EAST BERKSHIRE is bounded by the River Thames from Reading to Windsor in the north, by Middlesex and Surrey in the east, and by Hampshire in the south. Its western edge roughly follows the road from Reading to Sandhurst. Although it is the smallest district in the county, it has the largest number of holdings: just on 1,500, ranging from 10 to 1,000 acres in size, with an average acreage of 35. Because London is so close and easily reached, not all of the farming population depend wholly on agriculture for a living. In spite of this they are keen to farm well.

The district can be divided roughly into three areas. The first is between the Thames and the Reading-to-Maidenhead road, on the upper chalk; the second, a broad band due south of the first, runs from Reading to Windsor on London Clay. The third, south-east of the second, is on Bagshot sand. The three soil types have considerably influenced the systems of farming practised.

The highest land in the district is to be found in the first area, reaching 475 feet at Ashley Hill. Upper chalk is the predominant soil type here, the area being cut off from the Chilterns by the Thames valley. In spite of the denudation of the woodlands during the last war, this part is still pleasantly wooded. The farms vary from 150 to 400 acres in extent; pedigree herds of beef and dairy cattle, pigs and flocks of sheep are all to be found here, with a considerable amount of arable land.

The bulk of the district is in the central band of London Clay stretching across from Reading to Windsor. If the first area is highland, then this second area is very definitely low lying, and poorly drained. The farms are from 25 to 120 acres in extent, with a few reaching the 400-acre mark. The system of farming is mixed, but milk production is the main source of income, with pigs and poultry as subsidiary enterprises.

The arable part of the system is devoted to the growing of cereals and leys for the livestock. Flocks of sheep are slowly reappearing, despite the very considerable dog population. Because the land is heavy and wet, permanent grass is predominant, the herbage often containing a high proportion of water-grass and buttercups. However, with the use of modern herbicides, adequate fertilizers and a higher standard of management, these pastures can be greatly improved. On the stock side there is a wide range of breeds of cattle, including Belted Galloway, Aberdeen-Angus, Jersey, Guernsey, Shorthorn, Ayrshire, Friesian and Red Poll. Although beef breeds are represented, these are mainly pedigree herds from which animals for breeding or for meat are produced. There are also a few herds of commercial cattle.

The third area of the district, on the Bagshot sand, includes the new town

of Bracknell, built to relieve the congestion in London. The building of this new town has of necessity incurred a loss of agricultural land, but the light and airy buildings and houses, wide roads and imaginative layout make the onlooker realize that a new town need not be a tragedy for farming England.

Here the soil is light, sands and gravels predominating. A large area is covered with conifers, birch and scrub, the soils being the most infertile in the district. But this does not mean they are the worst farmed: under suitable management, output is high. The very poor soil has excessively high natural drainage and is dependent on rainfall for moisture. Most of the area is under permanent grass; ley farming is practised widely. There are, however, several large and intensively-managed market gardens, which produce heavy crops of potatoes, lettuces and brassicas, with the help of farmyard and inorganic manures.

Even in such a small area as East Berkshire, the rainfall varies by several inches a year. The northern and southern parts of the district on the chalk and on the Bagshot sands reach a total of 27 inches, while the central area of London Clay has an average rainfall of 22½–25 inches, as do certain areas in East Anglia. Grass and horticultural crops are irrigated in those areas lying close to the rivers and streams, and the increase in yields is appreciable.

The district is fortunate in having within its confines such well-known research and teaching establishments as the Grassland Research Institute, the National Institute for Research in Dairying, the I.C.I. research station, and Reading University's farms at Sonning and Shinfield. There is no county show, but there are three separate societies which arrange their own shows and competitions. The enthusiasm of the members is such that all three societies flourish.

Proximity to London, and the needs of the urban population, have created a demand for horticultural products. Market gardens, nurseries and seed testing stations enhance the roadside scene, in addition to meeting a need. A more recent effect of environment is the rapid growth of interest in broiler production. Within three miles' radius of Wokingham a number of broiler houses have been erected and the total annual output is in the region of 150,000 birds.

Recently the County of Berkshire was honoured with the prefix "Royal". The connections between the Royal Family and the county go back a very long time. It would be doing an injustice to the district not to mention Windsor and the historic castle where Her Majesty and her family frequently stay. The Queen and the Duke of Edinburgh are keenly interested in progressive farming, a fact which the royal farms demonstrate clearly.

The Crown Estates, run by the Crown Commissioners, include the considerable acreage of Windsor Great Park. As much of this land as possible is farmed; heavy crops of cereals and grass are produced, in addition to beef and dairy products. Most of the Great Park is open to the public, and here is to be seen some of the loveliest wooded country in Britain.

Agricultural Statistics England and Wales

JUNE, 1957. AGRICULTURAL RETURNS (FINAL)

CROPS AND GRASS

(thousand acres)

DESCRIPTION	1956	1957
Wheat	2,214	2,032
Barley	2,120	2,390
Oats	1,490	1,320
Mixed corn, for threshing	410	328
Rye, for threshing	24	24
Total corn	**6,257**	**6,095**
Beans, for stockfeeding	105	86
Peas, for stockfeeding	19	14
Potatoes, first earlies	110	96
Potatoes, main crop and second earlies	525	469
Total potatoes	**635**	**565**
Turnips and swedes for stockfeeding	252	244
Sugar beet (for sugar)	412	415
Fodder beet (all types of high dry matter content)	17	14
Mangolds	169	148
Rape (or cole)	114	118
Cabbage, kale, savoys and kohl rabi, for stockfeeding	337	345
Vetches or tares	24	16
Mustard, for seed, fodder or ploughing in	32	32
Linseed	2	(a)
Flax, for fibre		(a)
Hops	20	20
Orchards with crops, fallow or grass below the trees	250	241
Orchards with small fruit below the trees	8	8
Small fruit, not under orchard trees	29	30
Vegetables (other than potatoes) for human consumption and grown primarily for sale, hardy nursery stock, flowers and crops under glass	467	419
Fruit and vegetables, not grown primarily for sale	9	8
All other crops	44	46
Bare fallow	209	305
Total of crops and fallow (tillage)	**9,410**	**9,171**
Lucerne	102	101
Temporary grass (including clover and sainfoin) for mowing	2,203	2,376
for grazing	1,736	1,798
Total	**3,940**	**4,174**
TOTAL ARABLE LAND	**13,452**	**13,447**
Permanent grass for mowing	2,966	2,897
Permanent grass for grazing	8,056	8,143
Total	**11,022**	**11,040**
Arable and permanent grass temporarily out of use through flooding on the East Coast January/February 1953	11	4
TOTAL ACREAGE OF CROPS AND GRASS excluding Rough Grazings	**24,486**	**24,491**
Rough grazings:		
Sole right	3,658	3,626
Common rough grazings	1,483	1,482
Total rough grazings	**5,142**	**5,108**

(a) Included with "All other crops"

SMALL FRUIT

(*thousand acres*)

DESCRIPTION	1956	1957
Strawberries	16·7	16·1
Raspberries	2·8	2·7
Currants, black	10·4	11·5
Currants, red and white	0·9	0·9
Gooseberries	5·6	5·7
Loganberries and cultivated blackberries	1·2	1·3
Total small fruit	**37·6**	**38·2**

VEGETABLES FOR HUMAN CONSUMPTION, HARDY NURSERY STOCK, FLOWERS AND CROPS UNDER GLASS

(*thousand acres*)

DESCRIPTION	1956	1957
Vegetables for human consumption (excluding potatoes) grown in the open		
Brussels sprouts	48·2	42·6
Remaining spring cabbage (planted in previous year)	8·2	7·8
Summer cabbage	9·6	7·6
Autumn cabbage	5·7	5·1
Winter cabbage	14·9	12·8
Autumn savoys	3·2	2·6
Winter savoys	10·9	8·8
Kale and sprouting broccoli	2·2	2·5
Winter cauliflower or broccoli (heading):		
Remaining from previous year's plantings	2·3	2·3
Planted in the current year	8·6	9·6
Summer and autumn cauliflower:		
Early summer sown under glass and planted in the open	5·6	6·1
Late summer and autumn (open sown)	8·7	8·6
Carrots, earlies (grown for bunching only)	2·9	2·2
Carrots, main crop	29·4	25·3
Parsnips	4·9	3·7
Turnips and swedes	5·4	5·1
Beetroot	9·4	8·3
Onions, grown for salad	1·5	1·2
Onions, for harvesting dry	4·3	3·0
Beans, broad	7·9	9·9
Beans, runner	9·8	9·8
Beans, dwarf or french	2·5	2·7
Peas, green for market	36·4	30·8
Peas, green for canning or quick freezing	48·0	52·4
Peas, for harvesting dry:		
Marrowfats	79·8	56·0
Blues	25·1	22·0
Asparagus	1·4	1·5
Celery	4·6	4·5
Lettuce	7·8	7·1
Rhubarb	5·2	5·0
Tomatoes (growing in the open)	1·0	0·7
Other vegetables and mixed areas	18·7	17·5
Total	**433·8**	**385·2**
Hardy nursery stock:		
Fruit trees, fruit bushes and other fruit stock	3·9	4·1
Ornamental trees and shrubs	5·0	5·0
Other nursery stock (herbaceous plants, alpines, etc.)	3·9	4·0

Description	1956	1957
Bulbs and flowers in the open:		
Bulbs grown for flowers:		
Daffodils (Narcissi)	3·5	3·7
Tulips	1·6	1·8
Other bulb flowers	0·7	0·8
Bulbs grown for sale as bulbs:		
Daffodils (Narcissi)	1·3	1·5
Tulips	1·3	1·7
Other bulbs	0·2	0·2
Other flowers, not under glass	6·7	6·5
Total	**15·4**	**16·3**
All crops grown under glass	**4·4**	**4·5**

LIVESTOCK

(*thousands*)

Description		1956	1957
Cows and heifers in milk:			
For producing milk for the dairy herd		2,090	2,142
Mainly for rearing calves for beef		454	467
Cows in calf but not in milk:			
Intended for producing milk or calves for the dairy herd		361	361
Intended mainly for rearing calves for beef		86	85
Heifers in calf (first calf)		696	659
Bulls being used for service		64	60
Bulls (including bull calves) being reared for service		26	23
Other cattle:			
2 years old and over	Male (Steers)	561	530
	Female	563	511
	Total	**1,124**	**1,041**
1 year old and under 2	Male (Steers)	583	587
	Female	1,047	1,010
	Total	**1,630**	**1,596**
Under 1 year old (excluding bull calves being reared for service)	Male (Steers	634	624
	Female	1,089	1,072
	Total	**1,723**	**1,696**
TOTAL CATTLE AND CALVES		**8,253**	**8,130**
Number of Calvings Calvings which occurred during the three months preceding date of census			
Heifers that calved for the first time during March, April and May		174	172
All other cows that calved during March, April and May		587	601
TOTAL CALVINGS		**761**	**774**
Sheep one year old and over:			
Ewes kept for breeding		6,020	6,207
Two-tooth (shearling) ewes or gimmers		1,338	1,359
Rams kept for service		163	174
Draft and cast ewes		762	231
Wethers and other sheep			513
Total one year old and over		**8,284**	**8,485**
Sheep and lambs under one year old:			
Ram lambs intended for service		70	(a)
Other sheep and lambs		6,843	(a)
Total sheep and lambs under one year old		**6,913**	**7,521**
TOTAL SHEEP AND LAMBS		**15,197**	**16,006**

(a) Not collected separately

DESCRIPTION	1956	1957
Sows in pig	293	312
Gilts in pig	112	129
Other sows kept for breeding	160	166
Total sows for breeding	**565**	**607**
Barren sows for fattening	15	16
Boars being used for service	35	37
All other pigs (not entered above):		
5 months old and over	827	859
2–5 months old	1,836	2,024
Under 2 months old	1,112	1,216
Total all other pigs	**3,775**	**4,099**
TOTAL PIGS	**4,389**	**4,759**
Fowls 6 months and over	28,603	31,923
Fowls under 6 months old:		
Male	5,173	5,308
Female	32,066	31,094
Sex not known	2,606	2,344
Total fowls under 6 months old	**39,845**	**38,746**
TOTAL FOWLS	**68,448**	**70,669**
Ducks of all ages	984	1,114
Geese of all ages	452	428
Turkeys of all ages	1,881	1,762
TOTAL POULTRY	**71,766**	**73,973**
Horses:		
Horses (including mares kept for breeding) used for agricultural purposes or by market gardeners	105	87
All other horses and ponies (not entered above)	98	95
TOTAL HORSES	**203**	**182**

LABOUR

(*thousands*)

DESCRIPTION	1956	1957
Regular whole-time workers:		
Male, 65 years old and over	20·6	20·2
„ 20 years old and under 65	334·9	328·9
„ 18 years old and under 20	26·0	28·3
„ under 18 years old	36·1	35·3
Total	**417·6**	**412·6**
Women and girls	37·2	36·2
Total male and female	**454·7**	**448·8**
Regular part-time workers:		
Male, 20 years old and over	40·6	42·3
„ under 20 years old	4·4	5·1
Total	**45·0**	**47·4**
Women and girls	30·1	31·5
Total male and female	**75·1**	**79·0**
Seasonal and temporary workers:		
Male, 20 years old and over	42·7	42·2
„ under 20 years old	4·0	3·7
Total	**46·7**	**45·9**
Women and girls	33·1	33·8
Total male and female	**79·8**	**79·7**
Total male workers	**509·2**	**506·0**
Total female workers	**100·4**	**101·5**
TOTAL WORKERS	**609·6**	**607·5**

CROPS GROWN IN GLASSHOUSES*

	Jan. 1957	Jan. 1958
	acres	*acres*
Total Area of Glasshouses		
With heating apparatus	3,779	3,717
Without heating apparatus	779	799
Total	**4,558**	**4,516**
Crops in Glasshouses at January 15:		
Lettuce	545	515
French beans	2	2
Mushrooms	39	41
Tomato and cucumber seedlings	(a)	199
Other vegetables and herbs	128	56
Carnations	176	184
Roses	123	122
Orchids	10	12
Bulbs for forcing	(b)181	175
All other flower and foliage crops	468	450
All other crops not specified above	(b)259	166
Total	**1,931**	**1,922**
Remaining glasshouse area (being the area unused at January 15 or used for other purposes not shown above)	2,627	2,594
Total area of glasshouses	**4,558**	**4,516**
Chrysanthemums in Glasshouses		
Area of chrysanthemums grown in autumn and winter	829	840
Lettuce in Glasshouses		
Area of lettuce completely cleared before January 15	72	69
Area of lettuce as at January 15	545	515
Area of lettuce to be planted between January 16 and March 31	379	359
Bulb Flowers in Glasshouses		
Total number of flower bulbs forced, or to be forced, under glass during the winter season	219,527,000	208,035,000

* Includes Dutch light structures which were glazed at the census date. Holdings included in this census are those with 1,000 square feet or more of glass.
(a) Not collected separately in 1957.
(b) Corrected figures.

THE MINISTRY'S PUBLICATIONS

Since the list printed in the March 1958 issue of AGRICULTURE (p. 624) the undermentioned publications have been issued.

MAJOR PUBLICATIONS

Copies are obtainable at the prices quoted from Government Bookshops or through any bookseller.

BULLETINS

No. 20 Beneficial Insects (*Revised May 1958*) 5*s.* 6*d.* (5*s.* 10*d.* by post)
No. 36 Manures and Fertilizers (*Revised April 1958*) 4*s.* 6*d.* (5*s.* by post)

OTHER PUBLICATIONS

Experimental Husbandry No. 3 (*New April 1958*) 4*s.* 6*d.* (4*s.* 11*d.* by post)
Some Aspects of Dairy Economics (*New May 1958*) 3*s.* (3*s.* 4*d.* by post)

LEAFLETS

Up to six single copies of Advisory and Animal Health Leaflets may be obtained free on application to the Ministry (Publications), Soho Square, London, W.1. Copies beyond this limit must be purchased from Government Bookshops, price 3d. each (5d. by post) and 2d. (4d. by post) respectively.

ADVISORY LEAFLETS

No. 18 Cabbage Root Fly (*Revised December 1957*)
No. 115 Slugs and Snails (*Revised February 1958*)
No. 163 Onion Fly (*Revised February 1958*)
No. 323 Sugar Beet Yellows (*Revised December 1957*)
No. 350 Winter Cabbage and Savoys (*Revised February 1958*)
No. 377 Pollination of Apples and Pears (*Revised February 1958*)
No. 378 Pollination of Plums and Cherries (*Revised February 1958*)
No. 465 Design and Cropping of Mobile Glasshouses (*New Jan. 1958*)
No. 467 Potatoes for Stock Feeding (*New February 1958*)

ANIMAL HEALTH LEAFLETS

No. 35 Fowl Typhoid (*Revised February 1958*)

FIXED EQUIPMENT OF THE FARM LEAFLETS

No. 12 The Road of Local Material (*Reissue Jan. 1958*) 1*s.* (1*s.* 2*d.* by post)
No. 32 Proofing of Farm Buildings against Rats and Mice (*New February 1958*) 1*s.* (1*s.* 2*d.* by post)
No. 33 The Concrete Road (*New November 1958*) 8*d.* (10*d.* by post)
No. 34 Farmhouses and Cottages (*New January 1958*) 1*s.* (1*s.* 2*d.* by post)
No. 35 Ventilation and Insulation (*New March 1958*) 1*s.* (1*s.* 2*d.* by post)
No. 36 Pit Trench and Clamp Silos (*New February 1958*) 1*s.* (1*s.* 2*d.* by post)

HORTICULTURAL MACHINERY LEAFLET (New series)

No. 1 Glasshouse Heating Systems (*New March 1958*) 6*d.* (8*d.* by post)

FREE ISSUES

Obtainable only from the Ministry (Publications), Soho Square, London, W.1.

UNNUMBERED LEAFLETS

Avoidance of Accidents to Children: Farm Safety Regulations—Explanatory Note (*New March 1958*)
Farm Safety: Bulls (*New February 1958*)
Silo Subsidy (*Revised March 1958*)
Spray Drift Damage to Crops (*Revised March 1958*)

BOOKLET

Crop Protection Products: Approved List, 1958 (*free*)

Farming Affairs

Confusion in earmarks

When fat cattle, sheep and pigs are certified as eligible for subsidy, they are permanently marked to ensure that they are not subsequently re-presented for a second payment. These marks are applied to the left ears of home-bred cattle and to the right ears of home-bred sheep and pigs, and to the opposite ears of imported cattle and sheep. So if any animal is presented for the fatstock guarantee payment bearing in its certification ear any mark or mutilation (or for that matter with part of the ear missing—sufficient to deface or obliterate the Ministry's mark had one been applied) the animal will be rejected on the grounds that it might previously have been certified and ear-punched. Once bitten, twice shy. Any farmer who has had this experience takes good care to see that the same thing doesn't happen again. But farmers can largely help themselves in this matter.

If a farmer *must* have his own private earmarks or tags on his animals, he should try to avoid the certification ears. It is recognized that it is no easy matter for hill farmers, sheep breeders and all owners privately marking their fatstock to change a long-established earmark, and where they have no alternative to using the certification ears, it is important that they should use proper marking instruments—not knives or shears! Also they should keep the marks as small as possible: a whole ear or part of an ear missing ($\frac{1}{2}$-inch across for cattle and $\frac{3}{4}$-inch across for sheep and pigs) will be a "confusion mark", as it is called; it must be remembered, too, that small earmarks made on calves, lambs or pigs may grow with the animals.

Accidents happen, of course, and sometimes confusion marks are caused through no fault of the owners. Animals may be born with abnormal ears or they may have their ears torn by fighting or by the tearing out of ear-tags on wire. It pays to look at the ears of animals from time to time and, where such an accident happens, the farmer should notify the Ministry of Agriculture as soon as possible so that the animal may be registered and special arrangements made for its presentation when finished. When stock are being marked either for calf subsidy or for attestation, farmers should pay particular care to see that only the right ears of cattle are marked.

The many earmarks, both private and official, at present applied to the ears of fatstock create a serious problem for producers, and unfortunately alternative forms of marking which have been investigated are not, for one reason or another, practical propositions. Until such time as a satisfactory alternative method of permanent marking is discovered, the problem of confusion marks can be solved only by the co-operation and goodwill of all concerned. Farmers can best help themselves by careful and proper marking of their stock and, by so doing, help the Ministry to ensure that the fatstock subsidy goes where it is designed to go—to the producer.

At the Farmers' Club

IS HIGH FARMING A REMEDY FOR LOW PRICES?

"Economists seem to disagree with farmers even more often than they

disagree with one another," said Professor E. F. NASH, of the Department of Agricultural Economics, University College of Wales, Aberystwyth, when he began his address to the Farmers' Club on May 14. He then gave a thought-provoking and controversial analysis of the major economic problem facing farmers today—how to improve income at the current level of prices.

High farming he defined as farming that employs a high volume of inputs per acre and aims at a high volume of output, success being measured by the income that results—that is to say, the difference between input and output. Professor Nash pointed out that the difference cannot all be reckoned in money terms, for "some farmers are incautious enough to admit that they enjoy their work". Their enjoyment is part of their gain and ought strictly to be reckoned as part of their income, yet such non-monetary rewards elude statistical measurement.

In fact, straight text-book economics fail to supply a valid answer to the problem, not only because the job of farming leaves so much room for mistakes and so much scope for the successful to surpass the incompetent, but also because there are so many farmers.

Professor Nash suggested that the ordinary man, with limited resources, is likely to be cautious before employing them in enterprises he knows he does not fully understand. Many a man farms not to make a lot of money but because he likes the life, and there are many more agreeable ways of spending time than in keeping elaborate accounts. It would seem, therefore, that under-farming is likely to be more common than over-farming—"more potential income will be sacrificed by insufficient than by excess output".

Further, the pressure which rents would otherwise have exercised to increase farmers' output to its economic level has been greatly weakened, since rents are only about 60 per cent above pre-war, whereas prices of agricultural products have risen threefold. There is much evidence that on many small farms incomes are low because output is too low. Considerable numbers of small farmers could, therefore, find higher farming a means of improving their incomes at current prices and of maintaining them in the face of falling prices.

But, said Professor Nash, if higher output brings still lower prices, "the goal of a higher income for the smaller farmer seems to turn into a mirage that recedes as quickly as it is approached".

Escape from this difficulty would involve cutting costs without increasing output, or expanding markets to absorb increased output without simultaneously bringing about price reductions. The small farmer needs a high output per acre, regular incomings, and a relatively rapid turnover of capital. Inevitably, therefore, he depends heavily on milk, pigs and eggs, the production of which the recent price review sought to curtail because they all involve heavy actual or virtual subsidy costs.

"I see no escape from the conclusion that further growth of output is bound to increase the subsidy burden unless producers' prices are considerably reduced," said Professor Nash, adding that the falling prices which must result if the burden of subsidies is to be kept within limits will partly or wholly nullify the effects of greater efficiency in improving the small farmers' income. The only way out seems to be to reduce the total number of farmers and increase the average size of farms.

By protecting security of tenure, and keeping rents low and guaranteed

prices high, agricultural policy in recent years has tended to work in the opposite direction. Protection keeps the structure of agriculture rigid and inflexible and prevents its adaptation to changes in economic circumstances and advancing techniques of production. Professor Nash suggested that economic change must be met either by individual response to economic pressures, including those of poverty and bankruptcy, or by compulsion and administrative direction, with consequent loss of economic freedom for the individual. These problems are among the most challenging which our economic statesmanship now has to face.

Sylvia Laverton

Scottish fruit trials 1949–56

In 1949 the technical committee of the Scottish Agricultural Advisory Council appointed a fruit trials sub-committee to advise the Scottish colleges and Department of Agriculture on the planting of fruit variety trials. The outcome was the planting, starting in 1951, of soft fruit trials of raspberries, strawberries and black currants at Auchincruive near Ayr, Craibstone near Aberdeen and Liberton near Edinburgh. In addition, the main fruit trials were established at the Scottish Horticultural Research Institute at Mylnefield, near Dundee.

The importance of the raspberry industry to Scotland naturally centred interest on raspberry varieties, and trials were established to compare the Malling varieties Exploit, Promise, Jewel and Enterprise with Lloyd George and Norfolk Giant. The report* includes useful data on the season of flowering, picking periods and yields for the years 1953–56. Lloyd George carried the heaviest total crop, and yields from Malling Jewel were consistently good, with Malling Promise and Exploit only slightly behind. Malling Enterprise cropped less satisfactorily and Norfolk Giant still worse, except at one centre. The wet season of 1953 favoured Malling Enterprise, Malling Jewel and Lloyd George more than Malling Promise and Malling Exploit, both of which suffered from *botrytis* of the berries. In the summer drought of 1955, Malling Promise, Malling Exploit and Malling Jewel, all early varieties, suffered least.

For canning, the best results in six tests were obtained from Malling Jewel, followed by Malling Enterprise and Lloyd George. Jewel also gave the best results when quick frozen, with Malling Promise and Malling Enterprise coming second.

In the first strawberry trial, planted in 1952, only Royal Sovereign (M.48) and Auchincruive Climax were included. Three of the four trials were given up after two cropping years owing to the breakdown of Climax with June yellows. Royal Sovereign suffered more severely than Climax from *botrytis* of the fruit in wet weather, so supporting the view that it is of limited value in Scotland's unfavourable climate. Climax was preferred for quick freezing, but both varieties were considered suitable for canning. In the second trial, planted in 1956, Talisman and Redgauntlet are being compared at the three centres. Climax has also been included although affected by June yellows.

The black currant acreage in Scotland is small, factors limiting it including damage by frost and cold weather in spring, and slow ripening of the fruit,

* Scottish Agricultural Improvement Council—Fruit Trials Committee. Report of Fruit Trials in Scotland 1949–56. Price 2*s.* (post free).

which necessitates the picking of single berries. Trials planted in 1952 at each centre are designed to compare early, mid-season and late varieties.

Cropping has been inconsistent, but of the early varieties Laxton's Giant and Mendip Cross have been among the best croppers at three out of the four centres; at two centres Silvergieter's Black (an early Dutch variety said to be a seedling of Boskoop Giant) has cropped well and at only one centre was Boskoop Giant outstanding. Of mid-season varieties, Cotswold Cross has cropped well at all centres, Blacksmith at three out of the four, Goliath and Seabrook's Black at two, and Wellington XXX and Raven cropped really well at only one centre. Of the three late varieties, Baldwin yielded well at all centres, Amos Black at three out of the four and Daniel's September was outstanding at Auchincruive.

Leaflet No. 1 of the fruit trials committee gives a summary of the results included in the full report but covers the period 1953–57, which enables it to include also the results of the first year's cropping of the second strawberry trial. In this Redgauntlet flowered earliest and suffered most severely when frost came. At once centre, it suffered less than Talisman from *botrytis*. Preliminary cropping results show that at two out of the three centres, Talisman outyielded Redgauntlet.

Certified quality seed production in Wales

The first certification scheme for any seed crop in the United Kingdom was introduced for Montgomery late-flowering red clover in 1923. This progressive move was taken further in 1933, when a comprehensive cereal seed certification scheme was set up by the Clarach Valley Seed Growers' Association, and the North Wales Certified Seed Potato Growers began the certification of seed potatoes.

Thus certification schemes were developed by the growers themselves, through their associations, and were linked in 1942 with the formation of the Welsh Seed Growers' Federation, under the presidency of Sir George Stapledon and the chairmanship of the late Professor A. W. Ashby. (Sir George was at that time Director of the Welsh Plant Breeding Station.) The Federation today administers the Welsh Comprehensive Cereal Certification Scheme and regulates the production of seed potatoes and herbage seed.

Preliminary arrangements are now being made to celebrate the silver jubilee of seed certification in Wales, to commemorate the work of the pioneers, and stimulate scientists, advisers and farmers to promote quality seed production as part of an economic farming programme. Many Welsh districts are ideally suited to produce first-class seed stocks, though growers have not always made full use of this potential. The predominance of grassland makes it easier to avoid contamination of cereal crops, and most areas have an enviable freedom from noxious weeds. An article in the January issue of *Agriculture* on the problem of wild oats laid very proper stress on the value of certified stocks of seed in controlling its incidence. The Welsh Comprehensive Scheme has a strict nil standard for wild oats and several other weeds. The clean land conditions in Wales have made it possible to maintain this standard and to supply pure authentic seed of the improved strains and varieties of farm crops. Growers in Wales and Monmouthshire have every reason to be proud of their achievement, but they should not ignore the considerable scope for expansion in this specialized field.

Book Reviews

England's Forests. H. L. EDLIN. Faber and Faber. 30*s*.

Mr. Edlin has written many books on the more popular aspects of forestry. He has already addressed himself to those who are attracted by the craftsmanship of woodland work or are interested in the history of our forests, and to those who want to know what modern foresters are up to. In this volume the interest is mainly topographical, and the woodlands are dealt with county by county; he mentions and briefly describes the State forests and the major private woodland areas which might be visited during a leisurely tour from the north of England to the south-east, and thence to the south-west and back through Wales to the north-west.

Most of our present woods have been planted at some time or other, and it is doubtful whether a single acre remains which is unaffected by human use. Local differences in woods are mainly due to the species which the soil or climate will support, such as beech on the chalk downs and pines on the poorer heathlands, or to the products which local industry demands, such as hazel coppice for hurdles used for sheep rearing, or oak coppice for tanbark and charcoal. In some places it seems as though the most useful species have been removed so persistently that only the less useful remain, and it is tempting to ascribe the disappearance of Scots pine during the Middle Ages to this cause. Mr. Edlin is well aware of these influences and they are mentioned in the book; but, possibly because he has dealt with them more fully elsewhere, he does not use them as much as he might have done to provide a central theme in forest topography.

Alternatively, he might have provided a more coherent theme had he followed the lead of Daniel Defoe, Arthur Young and Rider Haggard, and given a personal account of the experiences and needs of local owners and cultivators. Instead of this, he seems to have relied on a rich store of statistics and maps, with the result that the book is informative rather than entertaining.

The photographs have been very carefully selected. They illustrate the variety of woodland scene, more especially in the Commission's forests, and depict many forest operations which are seldom seen by the general public.

Their brilliant reproduction enables the reader to pick out an amazing amount of detail and provides one of the most attractive features of the book.

W.E.H.

Schools and the Countryside. Ministry of Education Pamphlet No. 35. H.M. Stationery Office. 5*s*. 6*d*. (5*s*. 11*d*. by post).

If the countryside is to remain in a healthy state in these times of expanding urban populations, there must be a comparable growth in understanding between town and country. "Schools could help to bring about a better understanding to the benefit of both," say the authors of this booklet, which will make a strong appeal to teachers, parents, farmers and to the "countryman" that lurks in all of us. For teachers, there are signposts pointing to sensible and attractive lines of work; for parents, a picture of the aims of schools using the countryside in their task of educating children; for farmers, the knowledge that the schools are in sympathy with their problems; and for all of us a pattern of interests "deeply rooted in the countryside".

There are the expected chapters on natural history, crafts, the school garden, the keeping of livestock, and farm studies; also, in a natural manner and without any forced correlation, geography, mathematics, art and books are dealt with in relation to the countryside.

In these days when science is needed in rural as much as in industrial areas, it is a pity that room was not found for a chapter on "Science and the Country". True, the scientific approach is by no means neglected and scientific principles are stressed, but it would have been of value to have had the theme of the booklet continued through chemistry and physics. The photographs, although suitably illustrating some of the rural activities in schools, have not been well chosen. However, these are small points.

This is a work which can be read a second time to reveal new meanings in

teaching and different aspects of learning. A spirit sensitive to the nature of Nature and to the nature of man permeates the whole booklet, but its fuller meaning is in the last chapter, "Books and the Countryside". "Imagination," say the authors, "is the force that draws the child up to the stature of man and the man up to all that he has it in him to become, the spring of mental growth." We are not without critics of our educational system, especially of the various aspects of education through the countryside, but surely few, on reading this booklet, will fail to be impressed by such a helpful and inspiring lead from our educational leaders.

J.A.S.

Bird Study in a Garden. Puffin Picture Book No. 106. E. A. R. ENNION. 3*s.* 6*d.*

This colourful little publication is an excellent guide for the young student, written in plain language without trimmings or any hint of superiority. So many writers of this kind of book fall into the grievous error of talking down to their young readers. Here, the enquirer is told just how to go about the study of the birds which may visit or breed in his garden, in a manner that will please both his eye and his fancy, and all within the compass of 31 pages, of which a considerable area is taken up by illustrations. These, by the way, are very good.

There are two especially interesting features. The idea of the territory map, of course, is by no means new, but the map itself is very attractively put together and needs little more than a glance to be understood. The garden profile, however, is something of an innovation; I do not remember seeing anything of the kind before. In it, there is an idea for a new, pleasant and useful recreation for the young ornithologist.

In the whole of this book I can find but one fault—and this a minor one, concerning the use of the name "spotted woodpecker". From the relevant text and illustration it is clear that the bird referred to is the great spotted woodpecker, but perhaps in the next edition it might be made clear that there is also a lesser spotted woodpecker—a bird which admittedly is less likely to visit or to breed in gardens, but which nevertheless does both on occasions.

At 3*s.* 6*d.* *Bird Study in a Garden* is a bargain. It is educational in the best sense of the term, and education authorities might well consider its adoption as a special study book for use in junior schools.

F.H.L.

The Twelfth Oxford Farming Conference.

The Report and Proceedings of this conference, which was held in January 1958, is now available. Copies may be obtained from M. H. R. Soper, Department of Agriculture, Oxford University, price 6*s.* each.

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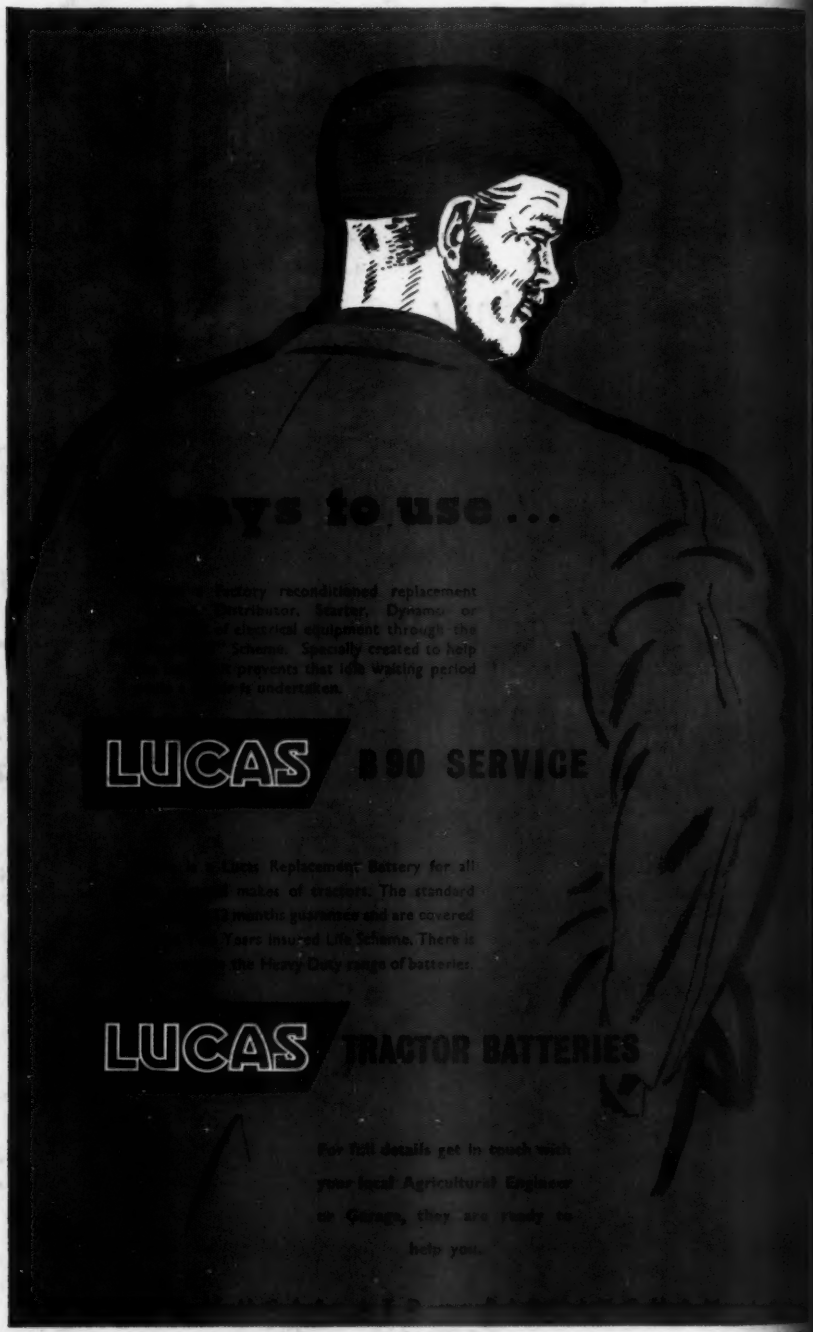
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